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INTRASENTENTIAL ANAPHORA AND DEAF READERS: A STUDY OF THE STRATEGIES USED BY DEAF READERS TO DISAMBIGUATE TEXT

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University of Arkansas

August 1989

Center for the Study of Reading

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Abstract

The manner of execution of pronominal referencing differs in English and in American Sign Language (ASL). Yet, without some means of establishing pronominal referents, it would be rather difficult for either language to communicate a coherent, cohesive message. Anaphoric referencing is important to text cohesion, and therefore to reading comprehension. In an attempt to continue the search for an understanding of why the deaf have trouble learning to read English, the following account describes a study that was designed to find out how deaf individuals resolve situations which require accessing pronominal referents. A paradigm developed by Cowan (1983) was used to get a clearer understanding about how deaf persons disambiguate small texts differently from hearing persons.

The results of the study show that the ability to construct meaning from written English in the particular forms manipulated in the study decreases as the deaf approach adulthood. Theoretical implications of the findings are discussed focusing in particular upon the shift away from English to ASL as a first language, and on what the consequences of this shift may mean for reading instruction.

INTRASENTENTIAL ANAPHORA AND DEAF READERS A STUDY OF THE STRATEGIES USED BY DEAF READERS TO DISAMBIGUATE TEXT

Few studies have examined the actual strategies that the deaf use to comprehend written text. Rather, the form of research has been primarily psycholinguistic studies at the lexical level comparing encoding preferences of the deaf with those of the hearing population (Conrad, 1979; Hanson, 1982, 1984, 1985; Hanson & Fowler, 1986; Lichtenstein, 1983, 1986; Locke, 1978; Quinn, 1981). There have also been linguistic studies that delineate specific syntactically controlled features in deaf production and comprehension of single sentences given reading tasks using sentences only (Fruechter, Wilbur, & Fraser, 1984; Wilbur, Montanelli & Quigley, 1976; Wilbur, Quigley & Montanelli, 1975). One recent study (Andrews & Mason, 1986) sought to identify the strategies deaf readers use to comprehend expository texts when using sign language to give the investigator their text interpretations. Essentially, this study gave a basic identification to some of the alternatives that good and poor readers use to understand factual texts and so to form schemata for such texts.

In 1976 Wilbur et al., emphasized the need to get to the heart of the strategies used by deaf readers. Their suggestion has received little attention. The very few studies available about the actual ways that deaf readers try to make sense of English have not given teachers much guidance for improving reading instruction. Current statistics indicate that most deaf adults in the United States reach barely a fourth grade level of reading proficiency. Because of the nature of the testing instruments, even those estimates may be inaccurate and inflated (See Allen in Shildroth & Karchmer, 1986). Besides just identifying what the deaf reader does in reading a text, we need to know from where the strategy, or strategies, originated. By determining the motivation of a specific reading strategy, we might be able, consequently, to address better ways for reading instruction to be conducted with deaf children.

The research reported here was designed to study how deaf readers deal with pronominal reference in the text. Pronouns play an important role in text cohesion, and deaf readers are known to have difficulty resolving pronominal reference. This research goes beyond a concentration on surveys and classifications about elements of texts that give deaf readers trouble, and attempts to explain the basic processes in the reading behavior itself.

General Issues of Pronominal Reference

Pronouns are very important, *subversive* elements in the English language or as Stoddard (1984) puts it, "It is in the nature of language that seemingly simple expressions show themselves, on close examination, to be disarmingly complex." Their manipulation in both oral and written language can either make a message very clear or cause great amounts of confusion and ambiguity. As the most frequently used means for referring, pronouns have been the source of many investigations in philosophy as well as in linguistics (Lyons, 1977; Reinhart, 1983; Stoddard, 1984). The study of text cohesion using pronominal anaphora is an important component in current research on how the mind processes language and makes connections, or makes sense, about how words and ideas interlock and refer to the real world. Charniak (1972) calls reference a "paradigm of understanding." It is, indeed, since the function of reference is to provide coherence and cohesion of written text and conversation.

The English language is flexible enough for oral conversations to be written out and understood quite clearly. Pronouns help in the accurate written description of an oral encounter. Simple explanatory phrases like, "he said," "she remarked," are indispensable in certain transcriptions of conversations. Of course, not all verbal interactions can be captured fully in writing. Facial expressions and body language as well as setting may carry the more meaningful pieces of a conversation. Thus, we have the expression: "I guess you'd have to be there to understand."

Various kinds of writing require true skill in manipulating those elements, like pronouns, that help establish cohesion. A writer must be careful to structure a text in such a way that each pronoun, definite description, and demonstrative clearly identifies its referent. Since the goal of reading is the apprehension of meaning, appropriate use of anaphora by a writer will show consideration for the reader who is trying to make sense of the text.

How an individual reader interprets a text is sometimes reflected in his/her own ability to write cohesively. Bartlett (1984) has exemplified this in her study of hearing junior high students. She found that poorer readers had little control of pronoun cohesion in their writing. Deaf individuals tend to show this same weakness in their writing. However, the basis for deaf readers' and writers' problems with pronominal reference may arise from certain characteristics of the sign language they use for their daily conversations. There is evidence along these lines as one observes the written work of deaf individuals. These difficulties and the connection to how referencing is accomplished in sign language are the topics of the next section.

Pronominalization and the Deaf

The study of pronominal reference in reading comprehension with the deaf must necessarily recognize that something quite different occurs in the "oral" conversations of the deaf using a sign language as compared with English. The majority of deaf children in the United States communicate using one of several variations of a sign language. And although educational settings for the deaf in the United States may try to incorporate signed communication that follows a strict English word order and syntax, what typically occurs between teachers and children is a modified, or pidginized version. This language representation may use signs for English words, but may also drop certain parts of sentences due to the speed of execution. A teacher or child may try to accompany the signing with speech, thus assuming that what may not have gotten said with the hands was said with the voice.

Deaf adults and deaf children of deaf parents (2% of the current population) use American Sign Language (ASL) which is a true language quite distinct from English. Since ASL represents the most clearly identifiable form of sign language, the following explanation of how pronouns are manipulated in English is contrasted here specifically with ASL.

Consider a situation involving a narration. For example, we can write the following, "*With fire in his eyes, John repeatedly banged his fist against the punching bag. And then his girl lost patience and left the room.*"

By comparison, a written ASL narration would require the writer to translate movements and bodily shifts into words that correspond to an English interpretation. The above example about John might appear to the listener as "*Eyes fire. Punching bag (outlined in a designated spatial location). Sweeheart (sign word for sweetheart in a space designated for the girl) frustrated, give up, leave.*"

The writer would have to recognize the need to translate repeated motions and sequences as well as missing descriptors (e.g., the room) into the appropriate English syntactic forms and words. Gaps occur when the spatial dimensions of the dialogue are ignored in transcription. What is more, there are several possible transcriptions of the event that can be written from ASL to English. And the ASL account given here is not the sole way of expressing the English facsimile.

Unlike spoken English, ASL resolves any possible ambiguity of anaphoric reference in the structure of its own unique syntax. There is an advantage to having two interdependent modes, manual (fingers and hands) and non-manual (i.e., unique usage of body and facial movement), facilitating the expression of a message. In a conversation, the signer indicates a point in space that defines a noun when initial reference is made to it. Continued reference to that object is accomplished by pointing, eye gaze and body shifts to its defined area (Padden, 1986).

Therefore, the equivalent of English pronouns in ASL is in the body placement and use of directive pointing rather than in specific lexical terms. In other words, although there are signs for the English words "I, you, we, us, they, our, your," etc., as an ASL conversation develops, directional gestures to a previously defined referent provide added clarity. Thus, *spelled out or signed* pronouns are unnecessary. If one is speaking of John and Joe, then each of these persons receives a position in space. Secondary reference to either is done by pointing to that individual's space, leaving no room for ambiguity.

The manner in which the verb of a statement is produced adds further clarification to the interactions of the antecedent being talked about. The utterance of the sentence, *Dick told Jim that he surprised Tom*, would be disambiguated by spatial placement of each name, emphasis in gesture to the intended referent for *he* and signing of the verb, *surprise*, in an appropriate degree of feeling from the referent to Tom. (A detailed explanation about the varieties of execution of pronominal reference in ASL is found in Wilbur, 1979 & Padden, 1986.)

Because of the distinct variety of essential components found in ASL but not in English, it is most difficult for a deaf individual to write down a conversation in English. Deaf people do not typically depend only on those aspects of language that are part of English syntax to express their ideas. In fact, the written English of the deaf demonstrates that they essentially capture only the manual aspects and do not recognize that by omitting the non-manual aspects (e.g., spatial, referential, repetitive verb) they have produced ungrammatical English (Jones, 1979). Notice the following example of the writing of an 18-year-old deaf person:

> "Mary, Mike, and their parents will go to the picnic at afternoon. His mother fix some sanwishes and put an their basket. His father wants to bring a bat and bat glove with Mike. They'll enjoys it. So his dog, Spot barks to their car, and leave it. Plus his father halts drive and Mike opened the door by his car. Mike hug with Spot, before they leave, so his family wants to come with Spot go to the picnic. Mike is happy with him. Mike's Spot going into his car. And They're arrived to the park for picnic, also the weather is pretty cool. Mary helped to her mother for fix some foods. His father and Mike played with baseball, and Spot barks and he like to enjoys with them. Their family has alot of marclous in the picnic." (18-year-old female, Performance IQ = 103, congenitally deaf, Better Ear Average 99dB, ISO: Example courtesy of C. M. King, 1978)

Although this individual is of average intelligence and quite fluent in ASL, the translation into written English has lost much of its cohesion.

To summarize this section, it appears that understanding characteristics of sign language, primarily ASL, may help reveal the reasons why deaf readers have certain difficulties in understanding and writing English.

Intrasentential Devices for Pronominal Reference in English

This section now discusses some of the characteristics of pronominal reference in written English. Rather than arguing for a formal description of pronouns, most of the discussion will center on the functional interpretation tendencies that have been observed in native English speakers and readers.

According to Chang (1980), a pronoun must reinstate or activate the meaning representation of its antecedent if comprehension is to occur. The variety of options for reinstatement in English has been the source for a wealth of studies about the referential puzzle (Blanchard, 1986; Chang, 1980; Corbett & Chang, 1983; Cowan, 1980, 1983; Dell, McKoon, & Ratcliff, 1983; Ehrlich, 1980; Grober, Beardsley, & Caramazza, 1978; Hankamer & Sag, 1976; Hirst & Brill, 1980; Murphy, 1984, 85; Sanford & Garrod, 1981; Yekovich & Walker, 1978). Problems in reading arise when the referent for a pronoun or

referring expression is not just one clearly perceived word, but rather a whole string of text or one word of several that receives its identity from other parts of a sentence or text (i.e., constrained by a verb or pragmatic situation). Consider the following example using the referring expression: "So did I". *Phil: "I just bought my mom a music box for mother's day." Sandy: "So did I."* In this example, the missing pieces in Sandy's comment (called deep anaphora) may be interpreted in two ways. She might mean that she bought a music box for Phil's mother. However, an alternative interpretation is that she bought a music box for her own mother.

Parallel function. One factor that influences the selection of a referent for a pronoun involves a consideration of the grammatical functions of each potential antecedent candidate. Using a strategy that Sheldon (1974) calls "parallel function," people show certain preferences for an antecedent when a sentence is ambiguous, as in *Mary put the book next to the tin can and then she opened it.* While either *book* or *can* is an appropriate antecedent for the pronoun *it*, there is a tendency for a reader to pick the word that matches the grammatical case of the pronoun. So, if *it* is a direct object, a reader would probably choose *book* as the referent since *book* is the direct object of the first clause.

Initially, Sheldon (1974) studied the child's acquisition of relative clauses in English. She found that children employed a strategy of interpretation that she defines in the following way:

> In a complex sentence, if coreferential NPs have the same grammatical function in their respective clauses, then that sentence will be easier to process than one in which the coreferential NPs have different grammatical functions. The grammatical function of the relative pronoun will be interpreted to be the same as its antecedent. (p. 274)

Sheldon also examined the interpretation of pronouns in conjoined sentences. Where there are problems of ambiguity in conjoined sentences, individuals also choose antecedents for pronouns according to parallel grammatical function. Her suggestion to examine the use of parallel function in adult English was followed by Cowan (1983) who expanded its definition as a processing strategy for intrasentential anaphora. Cowan's position is that in order for readers to process pronouns, they have to be sensitive to multiple factors in the pronominal clause at hand while being able to immediately integrate these factors with the preceding discourse in order to make a correct match. This position varies from other research which has either promoted a processing method by which a reader does a serial look-back to find a referent, or a method by which a reader holds the preread material "parallel" in mind and assigns the referent when the pronoun is encountered.

Cowan (1983) studied the perceptual strategies readers use for disambiguating sentences that have varied referential needs. He manipulated pronominal referents in four specific environments that he categorized as: syntactic, lexico-pragmatic, contextually determined, and lexico-syntactic-pragmatic. These areas were delineated in the research of Sheldon (1974) and Springston (1976). Observations from other literature show the influence of world knowledge upon the selection of appropriate referents. By focusing upon perceptual strategies, Cowan tried to find out what a reader's preferences are when given cases of intrasentential ambiguity.

Cowan compared the responses of a control population of native English speakers and an experimental group of non-native speakers of varying degrees of proficiency in English as estimated by the TOEFL Test. He predicted that the native English speakers would tend to read carefully for meaning and watch for incorporating world knowledge when necessary to pick an appropriate referent for a pronoun. The ESL group, he thought, would not be as precise and would revert to parallel function when faced with an ambiguous situation, regardless of the additional help of context.

Using reaction time as one measure, subjects were given sentences to read, one at a time, on a computer terminal. The sentences were randomized for each reader. They consisted of the four

different conditions that progressively incorporated greater syntactic, semantic, and pragmatic constraints.

One condition required the disambiguation of pronouns in sentences of the type *Mary put the book down next to the tin can and then she tried to open it.* In sentences like this one, research has found that most native speakers of English follow parallel function to pick a referent since there is little context to influence the choice of one noun over the other.

Cowan's second condition required disambiguation of sentences where some pragmatic information was given, as in *Mary put the banana down next to the recipe and then she began to slice it.* Here the verb, *slice*, guides the selection of the appropriate referent.

The third set of sentences was developed with two different kinds of verbs controlling the choice of antecedent. These verbs were selected based upon Springston's (1976) idea of an experiencer constraint. That is, in the English language there are some verbs that require a subject noun of a first clause to be chosen as a referent, while other verbs point more to the direct object of the first clause. For example, in the sentence *Jill told Sandy that Mary bored her*, one typically would not choose Sandy as the referent of *her* since it would run counter to social convention for Jill to tell Sandy what Sandy feels about Mary.

A final set of sentences was used to see whether world knowledge directed the choice of the referent as in *John saw the bike parked by the stop sign beneath a puff of smoke. He used that to tell his friend where the bike was.* Here, stable objects, such as stop signs, serve as better reference points than do temporary objects, such as smoke.

Results of this study showed that all individuals, native English speakers and ESL learners as well, tended to select antecedents according to specific parallel function constraints, but they also responded to constraints imposed by pragmatic and lexical environments. However, these constraints operate more strongly in people with greater experience with the English language.

Cowan's findings with ESL subjects may have relevance for deaf subjects since deaf individuals, in one sense, may be considered second language learners. Thus, it would be informative to use Cowan's design to compare the performance of deaf individuals on similar tasks.

One hypothesis that Cowan proposed, but that was not supported, concerns the possibility of a mechanical means of identifying referents by selecting the first potential antecedent to the left of a given pronoun. The author has observed patterns in deaf students' comprehension during reading that suggest the possible existence of such a simple strategy for dealing with pronouns. It was this observation that initially motivated the research described in this report.

Intrasentential Anaphora and the Deaf

Cowan's paradigm was used to investigate the bases on which deaf readers select an antecedent for a pronoun. This investigation differs from prior research with hearing impaired subjects in that the question is not how deaf individuals understand the pronoun, but rather, given pronouns in a text, how deaf individuals construct the meaning of the text as they read. The distinction is quite important.

All previous research on deafness and English pronominalization has concentrated on one of two questions: (a) How do the deaf compare developmentally with the hearing in their comprehension of specific pronoun usage in isolated sentences, and (b) Which sentential environments give the deaf the most trouble. The design of most studies has required an indication of comprehension using several formats: multiple choice response, fill-in-the-blank, and fill-in caption balloons from multiple choices available. This research has produced a list of the kinds of pronouns that tend to be easy or difficult for deaf readers to interpret from defined syntactic patterns (Montanelli, & Quigley, 1976; Wilbur, 1984;

Wilbur, Quigley & Montanelli, 1975). While these findings are important, if reading instruction is to improve, it is necessary to investigate how the deaf reader approaches the task of identifying the correct referent in sentences and across text.

Previous research has identified two strategies that occur in the deaf individual's production and comprehension of English sentences: object-subject deletion and object-object deletion. Object-subject deletion appears to be the dominant strategy (Wilbur, Montanelli & Quigley, 1976; Wilbur, Quigley & Montanelli, 1975). This strategy was pinpointed from two experimental environments, one in a conjunction combining task with pictures, the other, in a multiple choice task about conjunction. Both tasks were used to investigate language production and deaf subjects' judgment of grammatical acceptability.

For the first task, language production, the child was given two pictures and was asked to write a conjoined sentence describing both. For example, the child saw one picture of *The boy hit the girl*, and a second picture of *The girl hit him back*. A deaf child would commonly produce the sentence *The boy hit the girl and hit him back*. Thus, the child deleted the subject of the second clause improperly. It may be assumed that the child knew the proper sequence of events, reflecting upon their expression in sign language, but failed to express the sequence properly in written English. The child's employment of the object-subject deletion rule made the direct object of the first clause the unstated subject of the second.

According to Wilbur et al. (1975) hearing children rarely produce such deviant forms (less than 10% of those tested at ages 8, 9, and 10). Deaf subjects show an increase in usage of the object-subject deletion rule over age (20% at age 10 to 40% at age 18), an interesting case of progressively poorer performance with additional schooling. One hypothesis for why this decline in accuracy occurred is that the younger children were receiving steady instruction in English. Also, their exposure to ASL was probably minimal since very seldom do the majority of deaf children interact with deaf adults and teachers do not typically use ASL in the classroom. The older young adult deaf may use the deviant rule more often because of a reduction of communication in straight English and the greater use of ASL in their daily conversations. However, only a longitudinal study would reveal whether this is true.

Wilbur et al.'s (1975) second test of the object-subject deletion rule involved a multiple choice task for conjunction. Subjects were given sentences of the following type and were to select the correct conjoined interpretation:

Anne fed the cat. Mary gave water to the kittens.
1. Anne fed the cat and the kittens.
2. Anne fed the cat and gave water to the kittens.
3. Anne fed the cat Mary gave water to the kittens.
4. Anne fed the cat and Mary gave water to the kittens.

There are two foils representing the object-subject deletion rule (1 and 2). A third foil demonstrates the inappropriate deletion of the conjunction, *and*. Subjects, again, selected predominantly those answers that inappropriately deleted the subject of the second clause.

The second strategy found by Wilbur et al. (1976) was object-object deletion in conjoined sentences. When given two sentences of the kind *John bought the car, Mary wrecked the car*, deaf subjects, ages 10 through 18, find the following combination acceptable: *John bought the car and Mary wrecked.* Here the subjects drop the necessary object of the second clause and by omission show that they do not see a need to repeat it or to put an appropriate pronoun in its place. Again, one might say that a deaf individual certainly would find no need for repetition in a signed conversation. The execution of the verb, *wrecked*, would disambiguate the message and any repeat of the sign for *car* would be redundant to a signed interpretation.

The next section will discuss some empirical evidence of how deaf individuals use pronouns in written language and what they tend to identify as appropriate referents for sentence completion tasks.

Instructional Observations

The author has observed that deaf high school students frequently do not utilize world knowledge nor their lexical knowledge to identify pronominal referents in single sentences. Furthermore, in some cases where normal hearing individuals might be guided to select referents by parallel function, these deaf students showed no such tendency. In the following sentences, the choice of referents depends upon using the descriptive information correctly and using parallel function.

> Mom kissed Mary because [she] was proud of her report card.
> Bob told Joe the secret and [he] spread it to his friends.
> Pat hit Sue but [she] didn't mean it.
> Tom paid Bill because [he] owed him the money.

Regardless of the meaning of each sentence, deaf students would mark the referents for he and she as the first possible noun of the appropriate gender tracing back from the conjunctions.

Also, when given sentence completion tasks, students would favor matching the given pronoun to the last noun of the first clause, as in the following:

> The book fell off the shelf and it [was a broken shelf].
> Fred kicked the dog because he [was not good dog].
> John stopped smoking because he [the cigarette is bad for you].

The above examples were taken from exercises used in daily English class over a 5-year period. In both the identification task and the completion task, all that can be said from the students' responses is that in isolated sentences where the verb is active, there seems to be a tendency to disregard the reading and favor a strategy of *first noun back = pronoun referent*. While the data from these exercises were not extensive enough to draw any conclusions, they do suggest for the English teacher certain instructional directions to take in the next grammar unit. In fact, Fischler (1983) comments that emphasis on relating performance to correct completion tasks takes too narrow a view of comprehension. Thus, one cannot determine whether or not the students misinterpreted the sentences based upon their manner of completing them. They may have been thinking in an oral way, then writing down their picture of the conversational completion of each sentence. Perhaps the students envisioned the contexts as they would present them in sign language without regard to the differences of written English.

In order to find out if, indeed, deaf individuals do use their language facility to interpret text, what seems necessary is to assume a multiplicity of factors for correct translation, as Cowan has done, and then to test the validity of this assumption with the deaf.

Summary

In summary, the following areas have been emphasized: (a) There may be a strong connection between what the deaf individual does in his/her daily conversational language and the inability to comprehend written English; and (b) Since pronominal reference provides cohesion for written and oral English text, it may be a place to start for clearer understanding of the strategies deaf persons use in their reading.

Hypotheses

The following study was undertaken with the hope of finding out more about the strategies that deaf readers use for comprehending English text. Much of the design of this study was modeled after that of Cowan (1983). The primary question for the study was also derived from Cowan's work: Since the deaf are, in a way, second-language learners of English, will they select referents differently as compared to hearing native English speakers? Although Cowan did not see a difference in the way ESL readers resolved problems of ambiguity in his study, perhaps there are specific differences in the way deaf readers deal with the same kinds of situations. The finding of such differences could give guidance for reading instruction for the deaf.

Considering the preceding rationale the following three hypotheses were generated for a study of pronoun disambiguation by deaf readers.

HYPOTHESIS 1: Contrary to the definition of parallel function which claims that the perception of anaphoric connections involves the recognition of the grammatical function of potential antecedents, deaf subjects will select antecedents according to a strategy of selecting the first noun phrase to the left of the conjunction as the antecedent of the target pronoun in the second clause of a conjoined sentence.

HYPOTHESIS 2: Despite research to the contrary, deaf subjects will not regard any of the conditions established by the way sentences are structured in order to read them meaningfully. That is, if descriptive phrases, such as prepositional phrases or adjectives, are used in a sentence, the deaf reader will still select the referent of a pronoun in a mechanical way by tracing back from a conjunction to the first potential noun antecedent. The reader will not pay attention to the specific constraints imposed by certain verbs upon reading the sentence for meaning.

HYPOTHESIS 3: The tendency to choose the first noun back will prevail over the alternative correct strategy of picking the referent because of the pragmatic information that sets a bias in the mind of the normal hearing reader. The deaf reader will ignore the conditions imposed by real life situations in the sentences despite familiarity with all the words of the text.

In order to support or reject the above hypotheses, sample populations of deaf individuals and hearing individuals were given a simple task whereby they showed their determination of pronominal referents in sentences of the following kinds which were derived from Cowan's study:

1. Conjoined sentences that have strong parallel function "magnetism" as seen from past studies in the field (Sheldon, 1974; Cowan, 1983).
   [Hereafter called Parallel Function, Type 1 sentences]
   Example: *John put the briefcase down next to the box and then he opened it.*

2. Sentences that are constrained by verb types whereby knowledge of objects guides the selection of a referent.
   [Hereafter called Pragmatic 1, Type 2 sentences]
   Example: *John put the recipe next to the meat and then he began to slice it.*

3. Sentences that require attention to real world relations.
   [Hereafter called Pragmatic 2, Type 3 sentences]
   Example: *Mary watched the eagle pass a cloud near the oak tree and she used that to show Bill where the eagle had flown.*

4. Sentences of two verb types categorized for experiencer constraint (Springston, 1976). [Hereafter called Experiencer Constraint, Type 4 sentences]
   Example: *Marcia told Jill that Bob bored her.*
   (Type 1 Experiencer Verb favors subject, Marcia, as appropriate referent for "her")

   Bill told Fred that he feared Charles.
   (Type 2 Experiencer Verb favors object, Fred, as appropriate referent for "he")

The choice of a pronoun referent in the first set of sentences is resolved by following the common strategy of picking by parallel function. The second set incorporates a verb that influences the judgment of the correct referent. The third set requires that the reader think about the characteristics of entities in the world. The fourth set is disambiguated by certain perceptions of who is the correct experiencer of the verb in the second clause.

Method

Subjects

Several populations of subjects were secured for a simple paper-pencil task.

Deaf subjects were taken from two educational settings: one junior college program where students are mainstreamed, with interpreters, in all classes with normal hearing peers, but which has an ancillary unit where deaf students go voluntarily for extra English and reading instruction and tutorial help in their hearing subjects; and one large public high school in the western suburbs of Chicago which has a hearing student population of approximately 1,800 and a deaf population of 115. The deaf high school students have a special educational annex where classes are taught by 15 teachers of the hearing impaired. They also are mainstreamed in any class that is appropriate. In the latter case, interpreters are provided.

Both schools permit the use of a sign language system, instructionally that is Signed English. Signed English is not ASL. It is English performed manually with sign words for verb agreement markers, pronouns, and inflectional endings (e.g., -tion). Only those high school students were chosen who were receiving English instruction in a classroom for the hearing impaired with a teacher who uses sign language and voice.

Although all the subjects in the deaf classes were given the pronoun tasks, only data from those who fulfilled the following criteria were included in the analyses: (a) deafened before the age of 2 years; (b) no educational handicapping conditions present other than hearing impairment; (c) hearing loss > 71 dB in the better ear unaided (ANSI, 1969); (d) age range between 15 and 22; (e) intelligence within the normal range as estimated by tests appropriate to the hearing impaired.

For those subjects who fulfilled the five above conditions, further background information was obtained for comparisons to task performance: (a) etiology; (b) hearing integrity of the parents; (c) beginning age of formal education; (d) kinds of language exposure in school(s) and at home; (e) use of amplification; (f) contact with deaf adults; (g) most current reading level as estimated on the Stanford Achievement Test. (Hearing Impaired Edition, 1972 or 1983.)

Of 45 high school subjects given the tasks, 38 qualified according to the established criteria. Twenty-four college deaf students were tested. Of these, 20 fulfilled the criteria. Therefore, 38 high school deaf and 20 college deaf subjects were kept in the study.

A control group of 73 normal hearing students was obtained from the same high school as the deaf students. This group consisted of sophomore students from three English classes. All were reading at

grade level and were in instructional groups for students of average ability. None had any kind of physical or intellectual handicap. Two of the classes were taught by the same instructor.

The investigator decided that this age-level would provide a vivid contrast to the reading behaviors of the deaf subjects. Since the materials were fairly simple, it did not seem necessary to select a younger hearing control group based upon matched reading levels with the deaf, as is often done.

Stimulus Materials

Booklets were prepared containing 30 control and 30 experimental sentences. There were two sets of control sentences and two sets of experimental sentences for each of the four types (parallel function, pragmatic I, pragmatic II, and experiencer constraint verbs 1 and 2). These were paired into four booklets. The order of the sentences of each booklet were randomized by a computer algorithm.

Separation of the sentences was in two major orders, modeled after Cowan (1983). *Orders* refers to the placement of the possible referent in the first clause of a sentence in a position of parallel grammatical case to the pronoun in the second clause, or switching the potential referent to a second position in the first clause. This structure is exemplified in the descriptions of each sentence condition that immediately follows.

Experimental sentences. Sentences of Type 1 (Parallel Function) were divided into reverse and non-reverse orders. That meant that the positions of two phrases with possible antecedents found in the first clause were alternated to see the effect on choice according to Hypothesis 1 (e.g., Willie put the *dirty towel* next to the dirty t-shirt and then he began washing it. Reversed: Willie put the dirty t-shirt next to the *dirty towel* and then he began washing it). For this type, subjects saw three experimental sentences in reversed and three experimental sentences non-reversed antecedent phrase orders. A subject never saw any one sentence in both orders.

Sentences for Type 2 (Pragmatic 1) were patterned in the same way as the sentences of Type 1. In each set of six sentences, the verb in the second clause only applied sensibly to one of two phrases found in the first clause (e.g., Charles pulled *the small rug* over to *the bookcase* and then he painted it. Reversed: Charles pulled *the bookcase* over to *the small rug* and then he painted it). Choice of antecedent was determined by the pragmatics of the situation regardless of the reversing of the two possible referential phrases.

Sentences for Type 3 (Pragmatic II) were also put in an order similar to the first two types. However, the reversals took place across two sentences rather than within one only. That is, in a second sentence which directly followed the first, the reader had to pick the most logical referent for completion of the act described in the first sentence (e.g., Alan saw the pretty deer eating beside a *Coca-Cola sign* near *a bend in the road.* He used that to show Mary exactly where the deer was eating. Reversed: Alan saw the pretty deer eating near *a bend in the* road near *a Coca-Cola sign.* He used that . . .).

Sentences of Type 4 (Experiencer Constraint) were separated into two forms as indicated by the verb in the second clause of each. For this set of sentences, half had verbs that typically take an object as the experiencer and half had verbs that typically take a subject as experiencer. Manipulating the gender of the nouns in the first clause of each sentence set up an ambiguous situation and forced the choice of an antecedent, either following a strategy of parallel function or overriding that strategy because of sensitivity to the experiencer verb constraint.

The first clause of each sentence used the verb *tell* to instigate the meaning for the action of the experiencer verb in the second clause (e.g., Bill told Harry that he bored John).

It was stated earlier that there were two sets of experimental sentences and two sets of controls. For Types 1, 2, and 3 there were an equal number of control and experimental sentences (six for each

type). For Type 4, experiencer constraint, there were six sentences for each of two verb types. Thus, there were 12 controls and 12 experimental sentences for this set of sentences.

Control sentences. Two sets of control sentences were developed which matched the Types 1, 2, and 3, but which were unambiguous because of the placement of number constraints. That is, one of two possible referents was put in the plural form. The plural noun would be an incorrect choice as a referent for the pronoun *it* or the demonstrative *that* as used in the second clause. The controls for the Type 4, experiencer verb sentences, were unambiguous because of the use of two genders for the two names in each first clause; (i.e., Harry told Mary that he bored John).

Nine control sentences for gender constraint were included in each order of materials. These were used to judge the deaf subject's ability to read highly constrained simple sentences. If more than two of these were answered incorrectly, the data of that subject was discarded (e.g., Lisa made a chocolate cake for Jim and put frosting on it). Control sentences for gender constraint were conjoined by *and* and *but*. There was only one antecedent possible for the one personal pronoun placed in the second clause. The position of the pronoun in the second clause was varied in either subject or object position for each of the three singular third person personal pronouns.

Gender constraint sentences were developed by the investigator and sentences for conditions 1, 2, 3, and 4 were borrowed and adapted with permission from those used by Cowan (1983). All words in the sentences were within the first 1500 most frequently encountered words as designated by the *American Heritage Word Frequency Book* (Carroll, Davies, & Richman, 1971). Each block of sentences (for each type) was of the same length.

Procedures

Given the above student sample populations and materials, a simple procedure was used to administer the sentences. Instructions about the task were presented to each group of students (i.e., academic class) via a series of transparencies that showed six examples of two-clause sentences similar to those for the actual experiment. The pronoun in question, found always in the second clause, was underlined. Students were told that they could either circle or underline the referent in the first clause of each sentence. This procedure was demonstrated on an overhead projector.

In the case of the deaf students, the investigator used Signed English and voice to explain the task. Where there were variations in the word signs used by a given school, a local instructor was invited to add clarification.

After this brief introduction, one of four booklets containing the target sentences was administered randomly to each subject. The subjects were then told that they could continue answering the sentences in their booklets for the remainder of the allotted session. Since most academic periods are 50 minutes in duration, it was estimated that all 69 sentences would be completed in that time space. In fact, the task took the subjects an average of 30 minutes to complete.

Results and Discussion

Background Data

Initially all the background data for the deaf subjects was compiled to distill the appropriate sample for inclusion in the study. Two of the 38 high school deaf students fulfilled all criteria except that their Better Ear Average unaided was at 65 dB. After a discussion with their teachers, it was decided to keep these two subjects in the sample since both functioned more as deaf individuals than as hard of hearing. A composite of their background data showed them to have adopted many of the language mannerisms typical of profoundly deaf persons.

It was clear that the reading scores of the deaf college subjects were on the average considerably lower than those of the high school deaf. This was taken into account in the analysis of the data of the study task.

Hand-scoring and evaluating the individual responses for each sentence in the task revealed some important information which will be considered in the discussion section. (The background data of all the subjects can be found in Appendix A.)

Statistical Analyses

The first analysis was done employing a repeated measures ANOVA. The design was 3 (groups of subjects) x 2 (sentence types--controls and experimental) x 2 (conditions--nonreversed and reversed position of possible referents). Significant effects were assumed to have a probability value of $p < .05$. This analysis was run separately for the responses to the sentences of the four target sentence conditions (dependent variables). In the case of the Experiencer Constraint condition, Verb Types 1 and 2 were investigated separately.

A second analysis was done to see if reading ability had an effect on the significant differences between the deaf high school groups and deaf college groups (college reading ability $M = 3.94$, $SD = 1.35$; high school reading ability $M = 6.05$, $SD = 2.79$). In order to see if the subjects reading at higher levels were contributing significantly to the results, a decision was made to run a repeated measures ANOVA using the median reading achievement grade equivalent test score for the entire deaf population as a cut-off point separating abilities. This influenced the composition of cell sizes considerably. The median reading level for all subjects was 4.7. Only three deaf college students scored above that median, whereas 25 deaf high schoolers were in the range of 4.8 to 12.0. Thus, the results of this analysis are to be regarded with caution.

Each sentence group will be discussed independently for each repeated measures ANOVA followed by a more general commentary about the results. (All numerical data of the statistical analyses may be found in Appendix B.) Table 1, a table of means for the responses to sentences in each condition, is especially helpful as an aid to reading through the analyses.

[Insert Table 1 about here.]

Repeated Measures ANOVA Comparing Each Group of Subjects

Parallel function sentences. The first group of sentences were of the type

Jack pushed the new chair over to the sofa, and then he sat down on it.

Controls differed from the experimental sentences in that one of the two possible referent NPs was marked for number. Mean scores for the control and experimental sentences for each group of subjects are in Figure 1.

[Insert Figure 1 about here.]

In the case of the control sentences, correct responses to the non-reversed condition meant that subjects attended to the number constraint and used parallel function to select the correct referents. The reversed order required following only the number constraint to find the correct match for the target pronoun.

Even though the controls were marked by number, the deaf subjects failed to attend to this in many instances. Deaf high school subjects performed closer to the hearing subjects. Yet their scores reflect choosing the correct referent for only about two of every three sentences.

In the experimental sentences, the choice of a referent was intentionally ambiguous. Therefore, based on the findings of prior research, subjects should have consistently chosen by parallel function. Indeed, the hearing subjects did follow such a tendency for the majority of experimental sentences (M = 2.5 nonreversed, 2.7 reversed).

Both deaf groups differed from the hearing. The repeated measures ANOVA shows that the differences were significant for each group of subjects for both the control and experimental sentences in nonreversed and reversed orders, Sentence x Group effect: F (2,128) = 5.24, p < .0065; Sentence x Condition effect: F (1,128) = 40.29, p < .0000.

Further informal observations of the actual sentences indicated that some of the controls were frequently answered incorrectly by all groups of subjects. Two of these are worthy of comment.

> *Fred pushed the wooden chairs over to the bed, and then he sat down on it.*
> *Alice set the paper cups near the plastic bowl, and then she poured water into it.*

Hearing subjects chose wooden chairs as their answer approximately 23% of the time; and deaf subjects, approximately 70% of the time. In the second example, the hearing chose paper cups about 29% of the time, and the deaf averaged 60% of the time. These estimates were quite close for both the reversed and nonreversed orders.

Although it is beyond the scope of this paper to distinguish precisely why these subjects chose erroneously in these instances, one might surmise that perhaps the subjects preferred wooden chairs because one would be inclined to sit on a chair rather than a bed. Also, the subjects might have thought similarly that one usually pours water into a cup rather than into a bowl. Thus, many of the errors may have resulted from the effect of pragmatic constraints.

Several other erroneous choices made by the deaf groups appear to have been made because of a sense of treating the NP as a collective noun rather than a plural, as red socks in the example

> *Sally dropped the red socks next to the blue dress, and then she began washing it.*

There is some evidence that the deaf subjects did follow some sort of collective noun strategy in that the errors were the same in both reversed and nonreversed orders. If the deaf were merely not differentiating by number, then one would assume they would have just followed parallel function, or selection of the first noun back from the conjunction, in more instances, with greater consistency.

Pragmatic I sentences. Sentences for this set of variables were of the type

> *Al put the apple next to the book, and then he sliced it.*

Here the verb helps in the selection of a referent. Control sentences contained one distractor referent in the plural. Experimental sentences had both possible referents in the singular.

Mean scores for all groups of subjects are presented in Figure 2.

[Insert Figure 2 about here.]

Although the deaf high school subjects' performance was somewhat similar to that of the hearing subjects, both the deaf high school and deaf college subjects differed significantly from the hearing for each sentence type in both orders, reversed and nonreversed. Sentence x Group effect: F (2, 128) = 3.08, p < .0493.

Judging from the fact that there were fewer errors overall than on Parallel Function (Type 1) sentences, the nature of these sentences seemed to be more salient for reading than the straight parallel function sets of sentences. There were no sentences that were answered incorrectly substantially more often than others.

Pragmatic II sentences. Sentences for this set of variables required that a subject draw upon knowledge of how the world functions as well as upon an ability to read across two sentences to find a referent. An example of these sentences is the following:

> *Mark saw the blue fish jump close to a big wave which was near a large rock. And he used that to show his dad where the fish was.*

Mean scores for all groups of subjects are illustrated in Figure 3.

[Insert Figure 3 about here.]

In the control sentences, the deaf high school subjects and the hearing subjects responded similarly for sentences in the nonreversed condition. That is, given a constraint by number plus parallel function, both of these groups made fewer errors than did the college deaf. However, the deaf high school group had more difficulty when the control sentence referent was reversed. In other words, they frequently picked the wrong referent by parallel function when it was in conflict with constraints from number and world knowledge. For example, in the above sentence pair, deaf subjects would pick the referent, *wave*, over the *large rock* even if the pronoun clearly marked one or the other by plural (i.e., rocks = those, or waves = those).

Each group of subjects differed significantly in their responses to both the experimental and the control sentences in either order. There was no significant effect for experimental versus control sentence types, as was the case with the other two sets of variables discussed above. The differences occurred in the interaction of Referent Order x Group: F (2,128) = 8.58, $p < .0003$. The three-way interaction for Sentence Type x Condition x Group of Subjects, F (2,128) = 2.65, $p < .0746$, was not statistically significant.

An examination of the sentences and individual errors, suggested that there were some sentences, particularly in the controls, that were somewhat unnecessarily ambiguous. The occasional errors of the hearing subjects were on these sentences. One was particularly informative.

> *Ben saw the dog standing right by a white cow which was eating some pretty flowers. And he used that to point out the dog to the boy.*

The supposedly correct referent is white cow. Yet, many subjects chose pretty flowers, regardless of referent ordering. This could result from the subjects taking flowers collectively. Also, it is possible that the cow, like the wave, in an earlier cited example, may have moved, whereas some of the flowers may remain after the cow satisfied her hunger.

On a few rare occasions, subjects (primarily the deaf) circled the entire phrase (e.g., the wave near a large rock). That suggests that sometimes the subjects did not deal with the referents singularly.

Experiencer constraint sentences. Experiencer constraint sentences will be discussed according to verb type (i.e., Type 1 and Type 2).

Type 1 verbs: Sentences in this subset were constructed with one of four Type 1 verbs: amaze, bore, frighten, surprise. The nonreversed and reversed orders were brought about by switching the position of the pronoun in the second clause, as illustrated in the following control sentences:

Nonreversed: *Marcia told Jack that Bob amazed her.*
Reversed: *Marcia told Jack that she amazed Bob.*

For the experimental sentences, ambiguity was incurred by making both NPs of the first clause of the same gender.

Nonreversed: *Marcia told Jill that Bob bored her.*
Reversed: *Marcia told Jill that she bored Bob*

Mean scores for Verb Type 1 control sentences indicate that the deaf high school subjects and hearing high school subjects responded almost identically. Both groups selected the correct referent for nearly every sentence. This is illustrated in Figure 4.

[Insert Figure 4 about here.]

In other words, for the nonreversed condition these two groups followed the lead of the verb and attended to gender. In the reversed condition control sentences both groups chose the correct gender referent disregarding parallel function. Deaf college students, however, responded correctly for only about two of every three nonreversed and reversed sentences. Thus, they disregarded the gender constraint and did not regard the usual experiencer constraint of the Type 1 verbs. In the case of the reversed order of sentences, the deaf college students did not use parallel function as an additional strategy to choose the correct gender noun.

For the experimental sentences of Type 1 verbs in the nonreversed order, hearing subjects selected the subject NP of the first clause as the appropriate referent in almost every instance. Thus, the experiencer verb strongly influenced their choice for a given sentence. This was true for only about two of every three choices for the deaf high school subjects, and about one of every three for the deaf college subjects. This reflects a strong tendency in the deaf to ignore the Type 1 verb constraint and to respond on the basis of parallel function. This contrast can be seen in Figure 5.

[Insert Figure 5 here.]

For the reversed condition, there was a somewhat equivalent tendency for all groups of subjects to prefer the subject NP. Each group chose the subject as referent for only about two of every three sentences. In other words, when the second clause subject was a pronoun for a Type 1 verb context, it was more difficult to choose in the ambiguous situation. Therefore, parallel function seemed to direct the choice of a referent two thirds of the time.

The analysis of variance shows significant effects for all but the Sentence x Group, and Sentence x Condition combinations. In view of the above rationalization about the nonreversed and reversed order responses, the lack of effect for these two contrasts is appropriate. That is, an observation of the means for the responses of all groups for the controls shows that the hearing chose the correct referents by gender plus verb constraint approximately 98% of the time for both orders. The deaf subjects responded correctly 82% of the time.

For the experimental sentences the hearing followed the verb constraint 95% of the time for the nonreversed order; the deaf, only 54%. However, both the deaf and the hearing had difficulty with the nonreversed sentences, the hearing averaged selection by the verb constraint only 42% of the time and the deaf, 36% of the time.

There was a significant three-way interaction of Sentence x Condition x Group: F (2,128) = 15.62, p < .0000. Looking at the comparison of the means for each group, it appears to be the case that the two deaf groups were very different in their responses contrasted to the hearing subjects for the nonreversed experimental sentences. The source of the three-way interaction for each kind of sentence in a specific order for a specific group of subjects seems to be derived from the responses to the nonreversed experimental sentences.

At this point, it appears that there is no easy explanation for the results of the analysis. However, reference to Table B-6 in Appendix B may provide some further clarification as to which constraints seem to be directing the choice of an antecedent for the experiencer constraint sentences.

Type 2 verbs: Sentences in this subset were constructed with one of four Type 2 verbs: like, love, hate, fear. The nonreversed and reversed orders were brought about by switching the position of the pronoun in the second clause. However, to establish the verb constraint towards the direct object, the sentences in the nonreversed order had the pronoun as the subject of the second clause, and the reversed sentences had the pronoun in direct object position. (Sensitivity to this structure requires that a reader carefully compare the arrangements of the Type 1 sentences with the Type 2 sentences.) Examples of the controls for the Type 2 verbs are as follows:

Nonreversed: *Bill told Jane that he feared Charles.*
Reversed: *Bill told Jane that Charles feared him.*

Again, as with the Type 1 sentences, the experimental sentences for Type 2 were ambiguous because both possible referent NPs were of the same gender.

Nonreversed: *Bill told Joe that he feared Charles.*
Reversed: *Bill told Joe that Charles feared him.*

Deaf subjects and hearing subjects made correct gender choices in almost every instance for the control sentences. For the nonreversed control condition, subjects could be led to an answer by either gender or parallel function. For the reversed control condition, they had to attend to the gender constraint only, in order to be correct. Thus, the deaf, like the hearing, followed the gender constraints rather than parallel function. Mean scores for each group are illustrated in Figure 6.

[Insert Figure 6 about here.]

For the experimental sentences, hearing subjects resolved the ambiguity by choosing the subject in almost every nonreversed sentence. Deaf high school subjects responded in a similar fashion, although there were a few more selections of the object referent. Deaf college subjects contrasted to the other two groups choosing the subject NP for about 2 of every 3 sentences.

Therefore, although previous research has shown that normal readers tend to pick the direct object in ambiguous sentences where there are Type 2 experiencer constraint verbs, these subjects opted for parallel function in a majority of instances where the pronoun was situated in the subject position (i.e., nonreversed order).

For the reversed experimental sentences for Type 2 verbs, it seems that all subjects found it more difficult to select a referent for the pronoun. To pick the object NP meant following parallel function. Most subjects in all three groups used that strategy for two thirds of the sentences. Again, although the experiencer constraint verbs should have drawn strong choices of the direct object referents, the subjects in this study did not show a tendency to follow that typical direction. When the responses to both reversed orders of the Type 1 and Type 2 experimental sentences are examined, it appears that the clear distinction of a preference for the subject noun phrase for the Type 1 sentences and an object

preference for the Type 2 sentences is not that vivid. Mean scores for the experiencer constraint Type 2 experimental sentences are found in Figure 7.

[Insert Figure 7 about here.]

The analysis of variance shows significant group effects, F (2,128) = 12.51, p < .0000 and significant effects for all but the Sentence x Group combination. There is a three-way interaction for Group x Sentence x Condition, F (2,128) = 4.76, p < .0102. Judging from the means for the responses of each group of subjects to the experimental and control sentences in both reversed and nonreversed orders, this interaction appears to be derived from the distinct differences in the way that the deaf college students chose their answers, and from the variation in the way that all subjects dealt with the experimental sentences in the reversed order. Although the hearing subjects did show a rather consistent approach towards choosing referents following the gender constraint where necessary, their tendency to resolve an ambiguous situation for the Type 2 verbs was clearly by parallel function for the nonreversed order, yet not that distinct for the reversed sentences (64% selection by parallel function). There was no strong preference for the direct object referent for any of the three groups of subjects for either order; and yet, Type 2 verbs are defined by the way readers usually opt for the direct object in cases of intrasentential ambiguity.

Reading Ability Effects Among Deaf Students

The reading ability analysis yielded significant effects for the performance of the two deaf groups. These occurred on three of the five types of sentences analyzed: parallel function, pragmatic II, and experiencer Type 2 verbs.

Pragmatic II sentences. The analysis revealed that reading ability had a significant effect on the performance of the deaf groups, F (1,54) = 10.42, p < .0021, but that it did not interact with sentence type (control or experimental), condition (nonreverse or reverse), or subject group.

Experiencer type 2 verbs. There was a significant interaction of Sentence Type x Reading Ability for Type 2 verb sentences, F (1,54) = 5.09, p < .0281. In other words, in both groups (high school or college), deaf individuals of different reading abilities responded differently to these sentences.

A cursory glance at the mean scores reveals that the deaf college group reading below a 4.7 grade level differed the most in their answers to the nonreversed sentences for Type 2 verbs. Deaf high schoolers of the low reading ability group performed equivalently to the high ability deaf high school and college groups.

Thus, in the ambiguous cases for Type 2 verbs, the lower readers in the college group did not follow parallel function as a primary strategy. Yet, parallel function, particularly for the nonreversed Type 2 sentences strongly influenced how the hearing, the deaf high school, and the high level deaf college students selected referents.

Parallel function sentences. There were significant differences in the responses of the deaf groups due to Sentence Types: F (1,54) = 4.03, p < .0497; Sentence Type x Condition: F (1,54) = 7.18, p < .0097. The sentence effect carried into a three-way interaction of Sentence Type x Group x Reading Ability (F (1,54) = 4.03, p < .0497). Therefore, deaf subjects of different reading abilities in both the high school and college populations responded quite differently to the parallel function controls and experimental sentences, regardless of order of referents. This is shown in Figure 8.

[Insert Figure 8 about here.]

What is quite distinct is the opposing pattern of the high level college deaf for both the controls and the experimental sentences. Unfortunately, there were only three high college readers in the sample.

It appears that the deaf high school group and low deaf college group attended to the number constraint in the controls in fewer instances than the high deaf college group. However, both deaf high school groups and the low college readers followed a pattern similar to the hearing high school group for the experimental sentences. That is, they used parallel function to resolve the ambiguity. The high reader college deaf do not seem to be guided to use parallel function as a strong resolution strategy for the ambiguous sentences.

Figure 8 summarizes the means for the sentences regardless of sentence condition, reversed or nonreversed. The intention is to show the three-way interaction of the analysis of variance. However, the method for interpretation requires that the control sentences be read for correct selection by number. The experimental sentence scores are read for correct selection by parallel function. Taking the means for the control sentences separately for just parallel function, the situation is almost the same. This is illustrated in Figure 9.

[Insert Figure 9 about here.]

In summary, then, going back to the question of whether or not reading ability caused the significant differences between the deaf high school and college groups, the answer in the majority of instances is no.

Discussion

The hypotheses for this study involved predictions of how deaf readers might interpret intrasentential anaphora. Since the majority of the deaf population use some form of sign language in daily conversation, it was proposed that a study of their reading strategies for small contexts might eventually be linked to variations that occur in sign language interpretation.

Pronouns were chosen for sentential manipulation in order to observe several kinds of possible interpretive strategies. Pronoun referents were placed in contexts that varied the amount of world knowledge or grammatical sophistication that might help the reader resolve any possible ambiguity. The first of the three hypotheses asked the question: Will deaf readers follow parallel function to find a pronoun referent, or will they use a different strategy of always choosing the NP closest to the conjunction? Table 2 shows the strength of Hypothesis 1. The scores for each sentence condition answered by the NP conjunction strategy were expressed as percents for the two groups of deaf subjects. These scores reflect how much the strategy was used, regardless of the correctness of choice. It is obvious from the percent scores that the deaf high school subjects used parallel function more frequently than the college deaf.

[Insert Table 2 about here.]

The second hypothesis was a variation of the first. The distinction in Hypothesis 2 had to do with the possible choice of referents because of the way the surface structure of the sentence conditions was organized. Looking at the analyses of the data comparing each of the three groups, there does not appear to be such a pattern of selecting referents consistently by some surface word count disregarding meaningful reading. What did occur, particularly for the parallel function set of sentences, was the errant selection of a plural referent in the controls regardless of the nonreverse or reverse orders.

When reading ability was taken into account, all groups of deaf subjects performed similarly on most sentences. The only peculiar difference in response occurred in the parallel function experimental where the three high level college deaf made the fewest judgments by the strategy of parallel function.

For the other sets of sentence conditions the deaf high school group performed closer to the hearing control group than the college deaf as a whole, although the scores of the high school deaf were always lower than the hearing group.

Variations in response were not particularly attributable to a surface interpretation strategy. As was pointed out in the discussion of the results of the pragmatic II sentences, there seemed to be some sort of meaning-driven approach to the erroneous instances. This development was anticipated by Hypothesis 3.

Hypothesis 3 was included as the logical next step from the second hypothesis. That is, besides a mechanical (or surface) interpretation, might the deaf pay attention to pragmatics and knowledge of how the world functions? One set of sentences which attempted to get to that answer was the Pragmatic I set. In these sentences the clauses were simply combined and the choice of a referent should have been relatively easy because of the nature of the verb in the subordinate clause. The results showed that the deaf high school subjects performed in a fashion very similar to the hearing high school subjects. Significant effects for sentence type and condition indicate that something is different about the way that the deaf college subjects interpret these sentences.

World knowledge was incorporated to a greater degree in the Pragmatic II sentences. The purpose of this test was to see if readers pay attention to the way objects occur in the world. Thus, the correct referents were intended to be those that had permanence, such as rocks, signs, or trees. In spite of the tendency to follow parallel function, the reader ought to pick a more stable noun as the referent to the demonstrative pronoun, rather than picking an entity such as smoke, or a wave, etc. Occasionally it appeared that subjects in each group had trouble separating out an appropriate referent and might have erred because of choosing a larger phrase, such as *sign near a bend in the road.*

The question remains for Hypothesis 3: When the pragmatic is put into an ambiguous context, will individuals revert to parallel function to choose a referent for a target pronoun?

Conclusions and Implications for Future Research

The purpose of this study was to try to find out what strategies deaf readers use to disambiguate text. It was hoped that by manipulating intrasentential anaphora some specific interpretive patterns would emerge. However, all that was accomplished was the identification of a difference between the way deaf high schoolers and deaf college students translate small sentence contexts.

The choice of the two deaf populations was deliberate. That is, the high school students were chosen because of their constant exposure to English instruction. The deaf college individuals were chosen because they no longer received a heavy dose of English instruction. The latter were involved in technical skill training during the day and could voluntarily take English tutoring to help them with their classes. They also lived in small communities of deaf peers and used ASL consistently in their daily communication.

Since the deaf high school students used a minimal amount of ASL and lived in homes where they had to use English, it was assumed that English was more their primary language than it was for the college group. Therefore, it was hoped that the reading strategies that might have emerged would have been distinct for the high school and college groups. Although specific strategies did not emerge, this study found that the deaf high schoolers performed more like their hearing peers than did the deaf college students. These observations were not dependent upon the reading ability differences between the two deaf groups.

Thus, it might be important to find out if the move into ASL is making the difference. In other words, can future research designs pinpoint real reading strategies which originate from the distinctions between oral and written language preferences where deaf persons are concerned?

Furthermore, it may be that native English speakers who show difficulty with reading and learning the English language, may be using some of the same problem strategies as are expected from the results of further experimentation with the deaf. This may be possible since teachers in remedial reading settings often comment that their hearing students produce some of the same comprehension errors as the deaf (CAWP, 1981). Also, there is a growing body of research on cross-linguistic transference that identifies changes in the ways that native speakers of a particular language express themselves once they gain a certain degree of fluency in a second, acquired language (Durga, 1978; Ehri & Ryan, 1980; Mack, 1982; Magiste, E., 1979, 1982). The possible parallels, however, form the substance for a second line of work. Yet, unless there is a definite identification of strategic preferences and processes that deaf readers use, the only parallels that can be addressed are those of the lists of do's and don'ts as was explained at the beginning of this paper. That is, deaf students do follow some identifiable yet wrong ways of interpreting sentences written in English; deaf students do encode linguistic information in ways that differ from hearing students (dependent upon several crucial identifying factors, e.g., degree and time of acquisition of hearing loss) and deaf students do not typically go beyond a fourth grade reading level in adulthood.

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Authors Note

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Table 1

Means and Standard Deviations for Responses to Each Sentence Variable

Sentence	Deaf High School M (SD)	Deaf College M (SD)	Hearing High School M (SD)
Parallel function			
Controls NR	1.87 (0.88)	1.70 (1.07)	2.62 (0.49)
Controls REV	1.18 (0.93)	0.95 (1.09)	2.25 (0.68)
Experimental NR	2.11 (0.95)	1.60 (1.14)	2.52 (0.50)
Experimental REV	2.32 (0.84)	2.05 (0.99)	2.73 (0.45)
Pragmatic I			
Controls NR	2.58 (0.68)	2.25 (1.02)	2.92 (0.28)
Controls REV	2.47 (0.86)	1.90 (1.21)	2.82 (0.38)
Experimental NR	2.76 (0.49)	2.35 (1.04)	3.00 (0.00)
Experimental REV	2.66 (0.67)	1.70 (1.26)	2.82 (0.38)
Pragmatic II			
Controls NR	2.47 (0.73)	1.45 (1.09)	2.67 (0.47)
Controls REV	1.42 (0.91)	1.30 (1.17)	2.39 (0.70)
Experimental NR	2.37 (0.78)	1.85 (1.18)	2.62 (0.49)
Experimental REV	1.84 (1.10)	1.35 (0.88)	2.52 (0.53)
Experiencer Verb 1			
Controls NR	2.87 (0.41)	2.25 (1.02)	2.99 (0.12)
Controls REV	2.87 (0.47)	2.15 (1.14)	2.93 (0.25)
Experiencer Verb 1			
Experimental NR Sub	1.89 (1.11)	1.30 (1.13)	2.85 (0.36)
Experimental NR Obj	1.00 (1.06)	1.60 (1.10)	0.15 (0.36)
Experimental REV Sub	1.87 (0.93)	1.75 (1.29)	1.75 (0.98)
Experimental REV Obj	1.08 (0.90)	1.10 (1.25)	1.25 (0.98)
Experiencer Verb 2			
Controls NR	2.87 (0.41)	2.50 (0.94)	3.00 (0.00)
Controls REV	2.97 (0.16)	2.55 (0.89)	3.00 (0.00)
Experiencer Verb 2			
Experimental NR Sub	2.55 (0.83)	1.95 (1.14)	2.97 (0.16)
Experimental NR Obj	0.37 (0.79)	0.90 (1.12)	0.04 (0.20)
Experimental REV Sub	1.08 (1.02)	0.95 (1.31)	1.08 (0.95)
Experimental REV Obj	1.87 (1.04)	1.85 (1.31)	1.92 (0.95)

Table 2

Deaf Individuals Use Of First Noun Back Strategy

	Deaf High School %	Deaf College %
Types		
Parallel Function	.32	.38
Pragmatic I	.48	.42
Pragmatic II	.37	.45
Experiencer		
Verb I	.35	.45
Verb II	.36	.46
Overall	.36	.45
Total Use	.38	.42

Figure Captions

Figure 1. Mean Scores for Parallel Function Sentence (Type 1) for Deaf and Hearing Subjects.

Figure 2. Mean Scores for Pragmatic I Sentences (Type 2) for Deaf and Hearing Subjects.

Figure 3. Mean Scores for Pragmatic II Sentences (Type 3) for Deaf and Hearing Subjects.

Figure 4. Mean Scores for Experiencer Constraint Verb Type 1 Control Sentences for Deaf and Hearing Subjects.

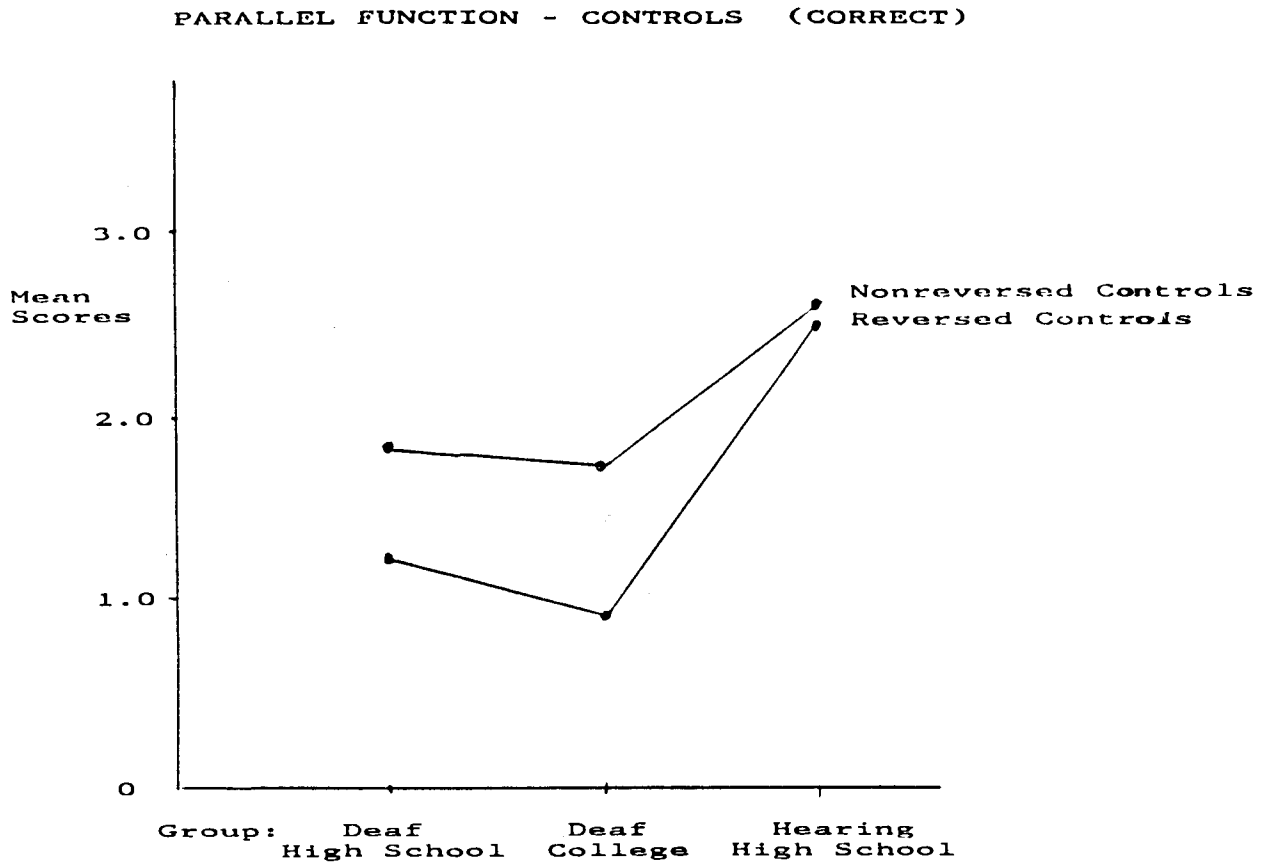
Figure 5. Mean Scores for Experiencer Constraint Verb Type 1 Experimental Sentences for Deaf and Hearing Subjects.

Figure 6. Mean Scores for Experiencer Constraint Verb Type 2 Control Sentences for Deaf and Hearing Subjects.

Figure 7. Mean Scores for Experiencer Constraint Verb Type 2 Experimental Sentences for Deaf and Hearing Subjects.

Figure 8. Parallel Function Sentence X Group X Reading Ability Effect Comparative Responses for Deaf Subjects of Two Reading Ability Groups Contrasted with the Responses of the Hearing Controls.

Figure 9. Separate Means for Parallel Function Responses to the Control and Experimental Sentences for Two Reading Ability Levels of Deaf Subjects Contrasted to the Responses of the Hearing Subjects.


PARALLEL FUNCTION - CONTROLS (CORRECT)
Mean Scores
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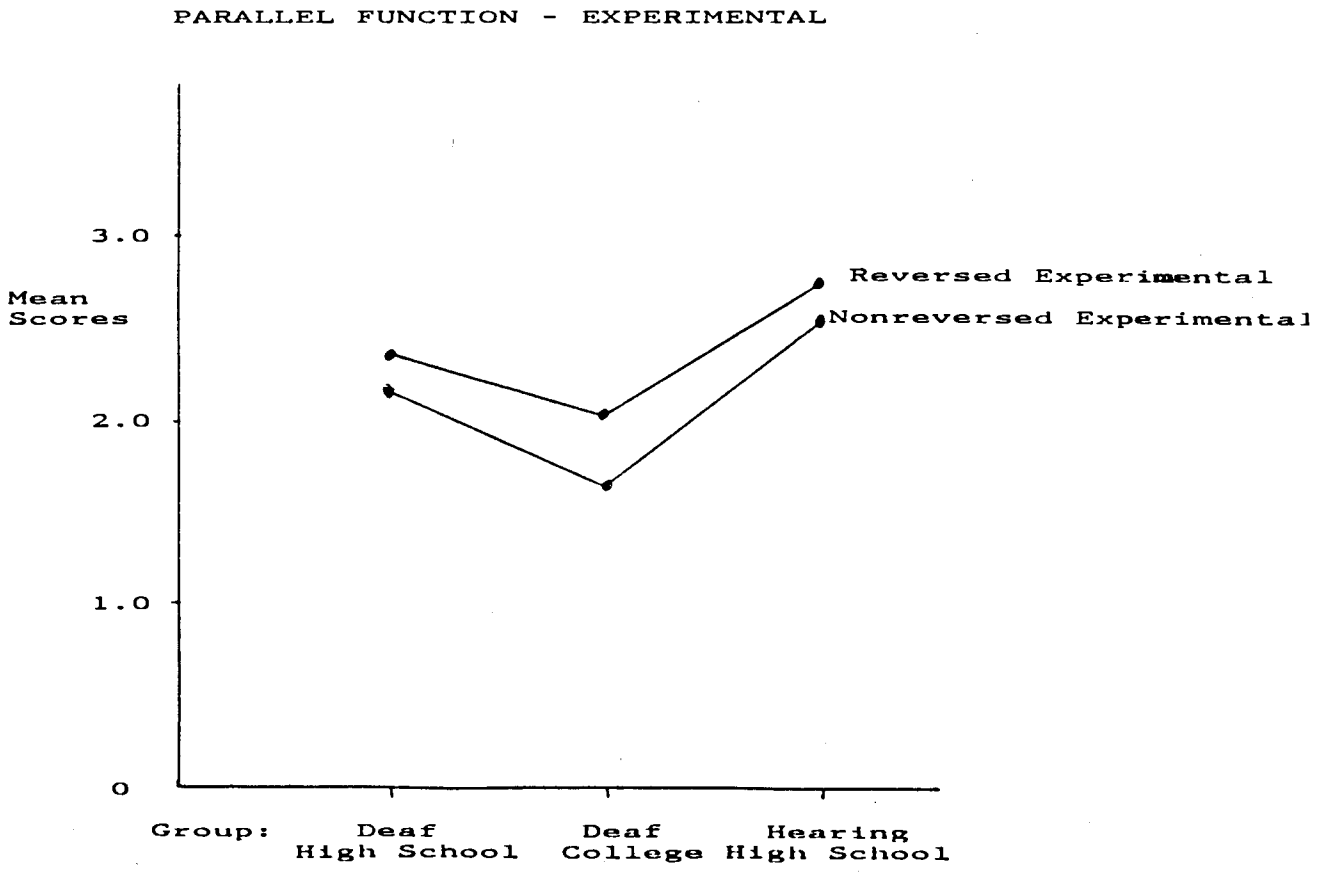
2.0
1.0
0
Nonreversed Controls
Reversed Controls
Group:
Deaf High School
Deaf College
Hearing High School

Figure 1


PARALLEL FUNCTION - EXPERIMENTAL
Mean Scores
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2.0
1.0
0
Reversed Experimental
Nonreversed Experimental
Group:
Deaf High School
Deaf College
Hearing High School

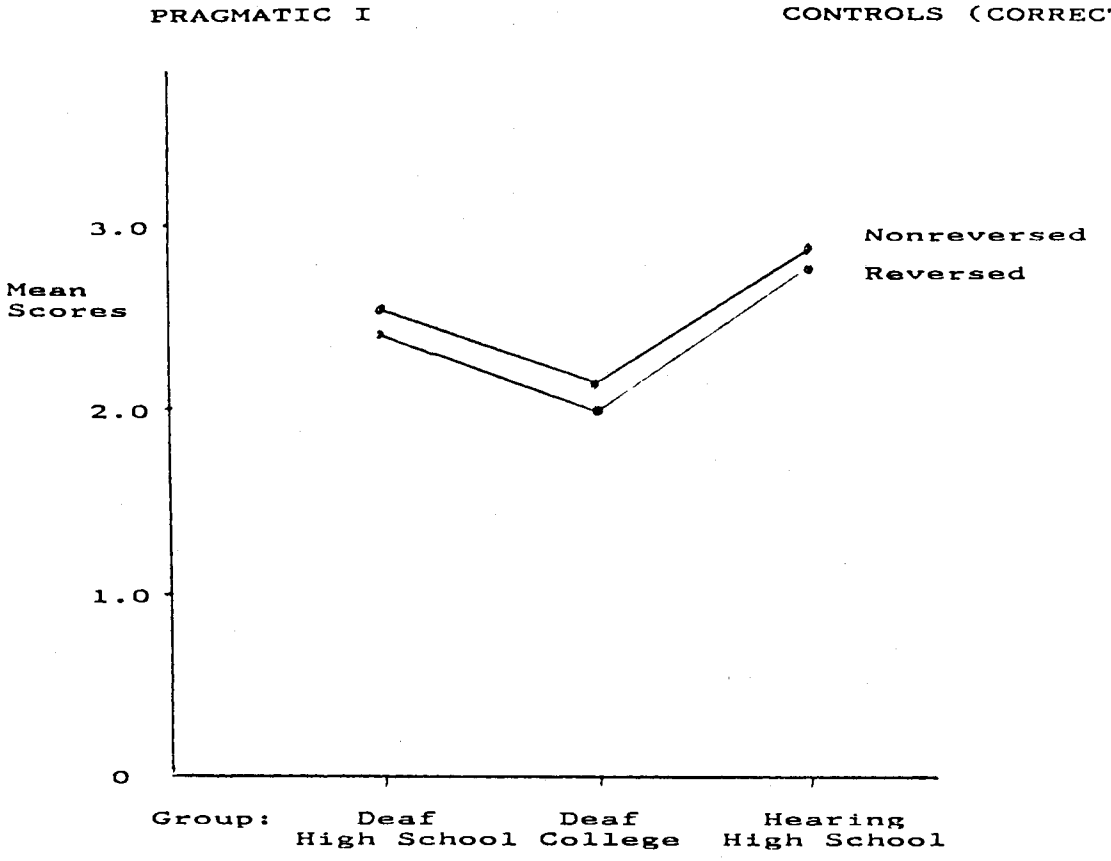
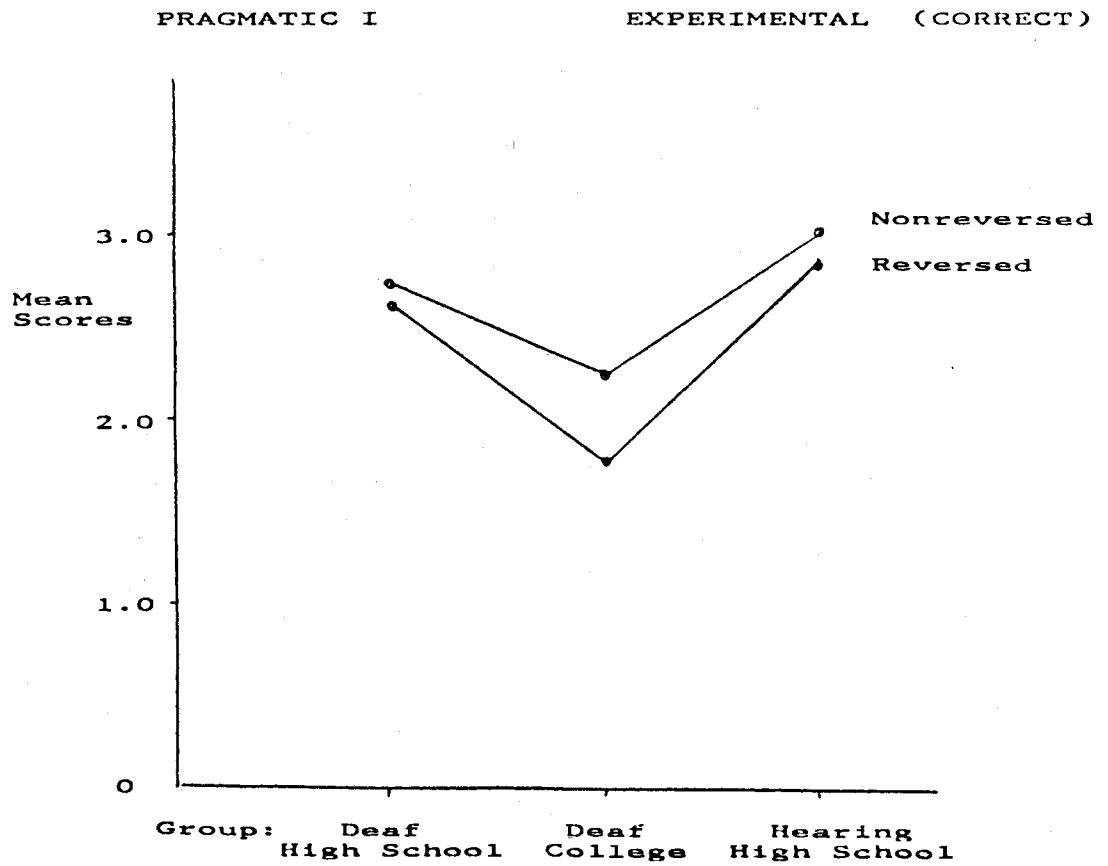
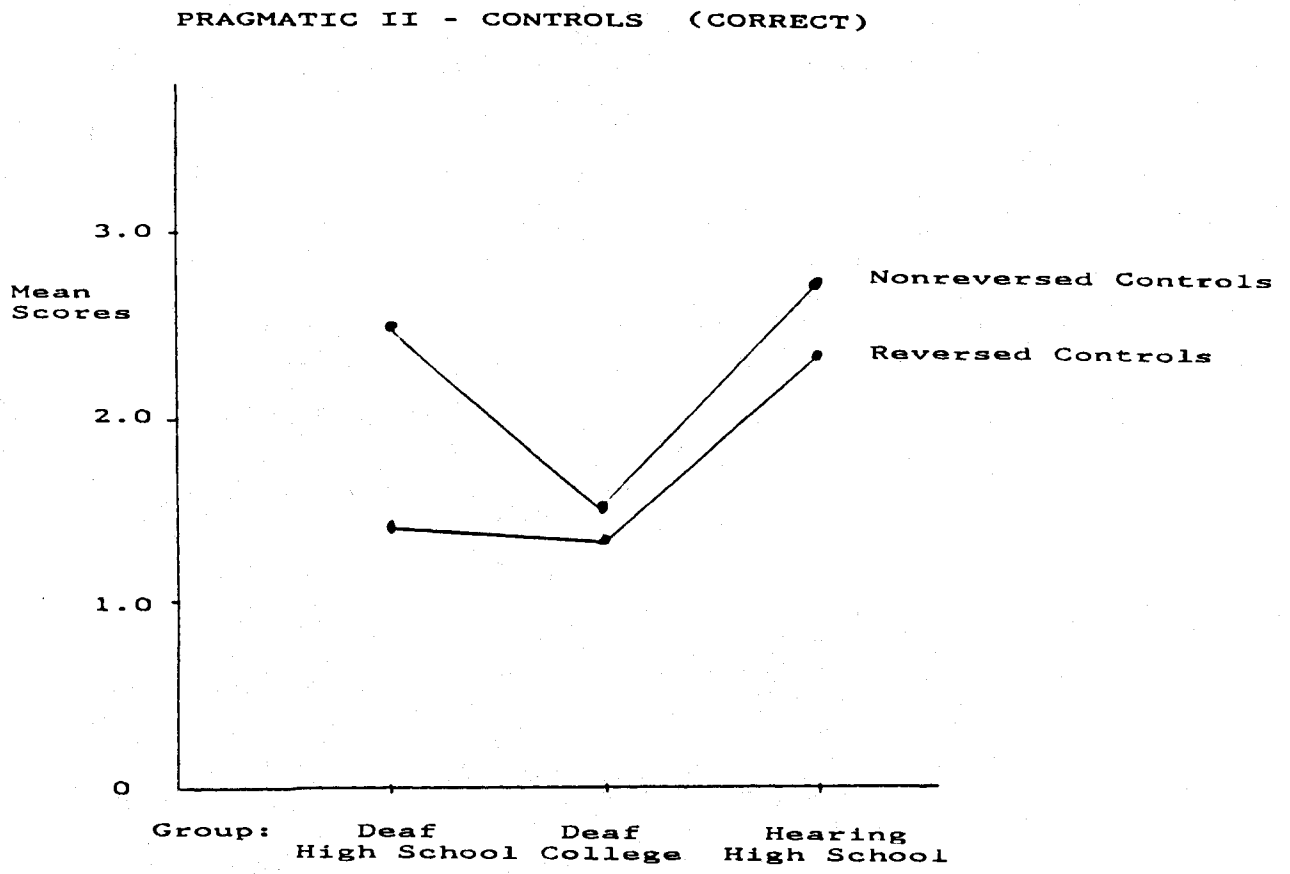

PRAGMATIC I
CONTROLS (CORRECT)
3.0
Mean
Scores
2.0
1.0
0
Nonreversed
Reversed
Group:
Deaf
High School
Deaf
College
Hearing
High School

Figure 2


PRAGMATIC I
EXPERIMENTAL (CORRECT)
3.0
Mean
Scores
2.0
1.0
0
Nonreversed
Reversed
Group:
Deaf
High School
Deaf
College
Hearing
High School


PRAGMATIC II - CONTROLS (CORRECT)
Mean Scores
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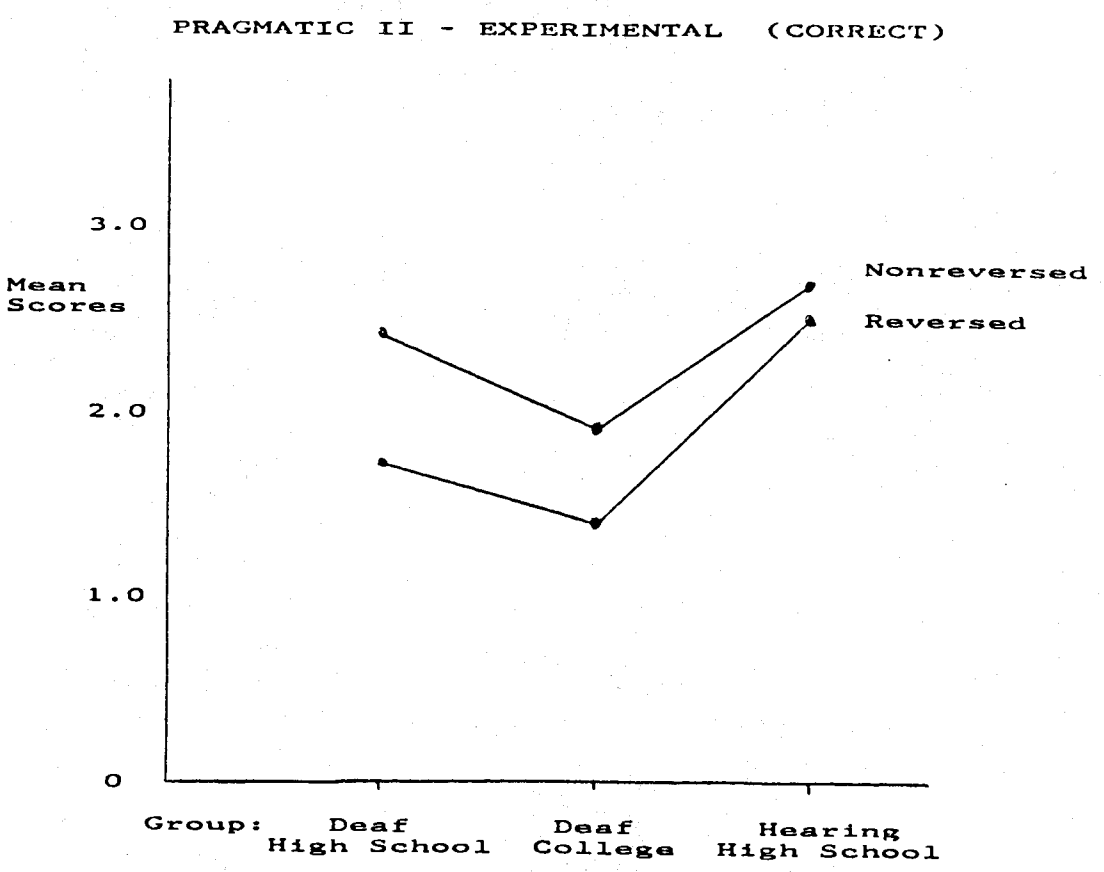
2.0
1.0
0
Nonreversed Controls
Reversed Controls
Group:
Deaf High School
Deaf College
Hearing High School

Figure 3


PRAGMATIC II - EXPERIMENTAL (CORRECT)
Mean Scores
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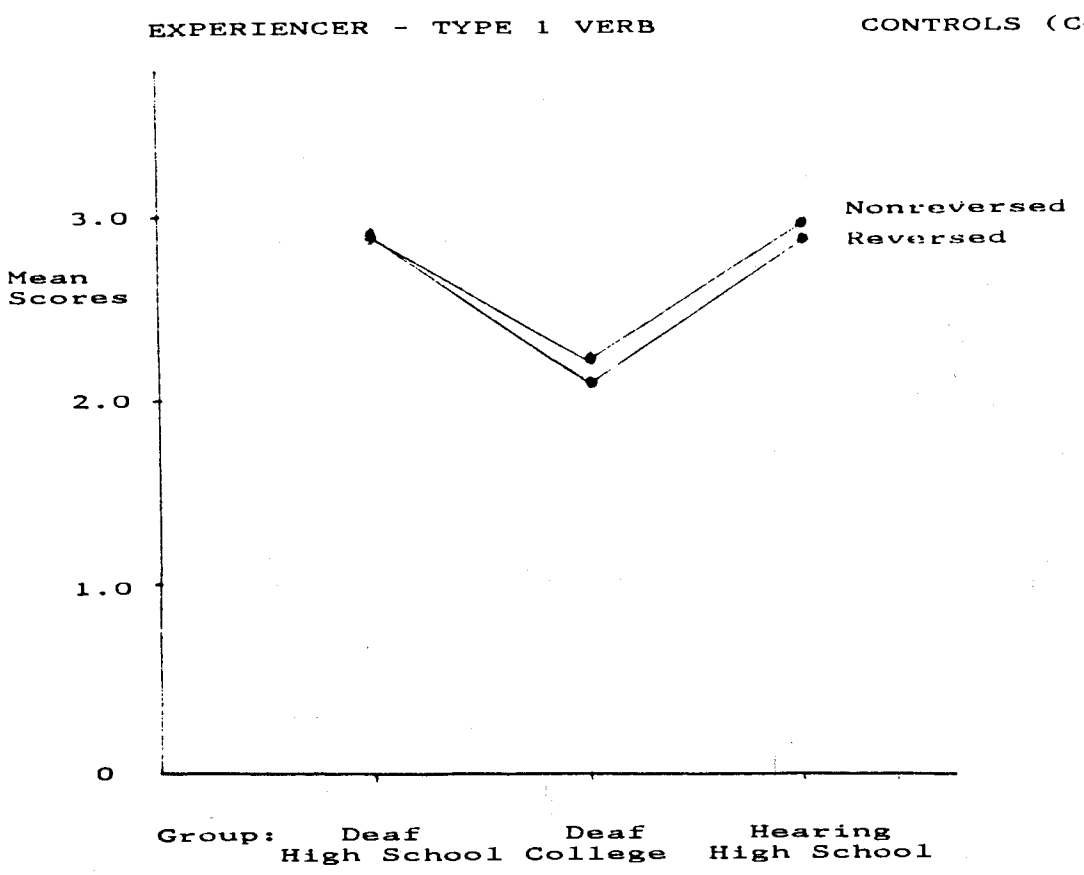
2.0
1.0
0
Nonreversed
Reversed
Group:
Deaf High School
Deaf College
Hearing High School


EXPERIENCER - TYPE 1 VERB
CONTROLS (CORRECT)
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2.0
1.0
0
Mean Scores
Nonreversed
Reversed
Group:
Deaf High School
Deaf College
Hearing High School

Figure 4

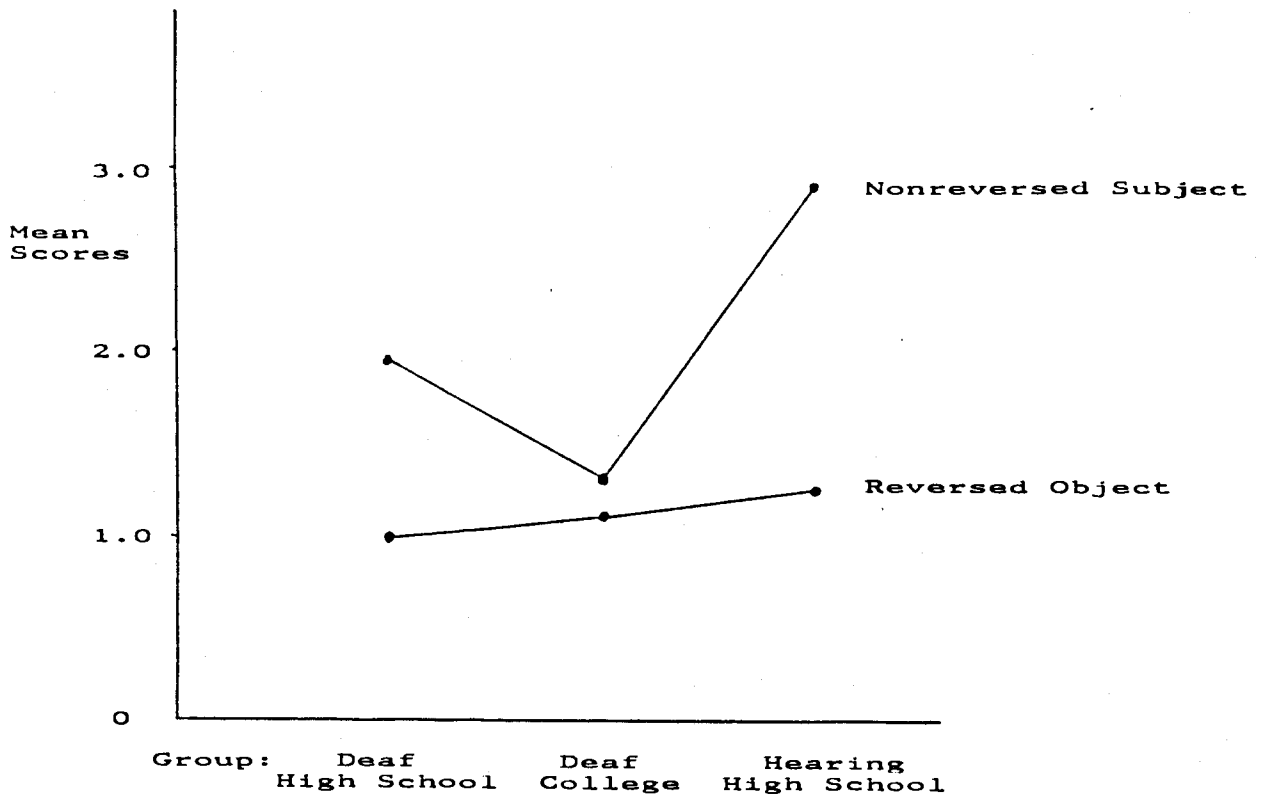
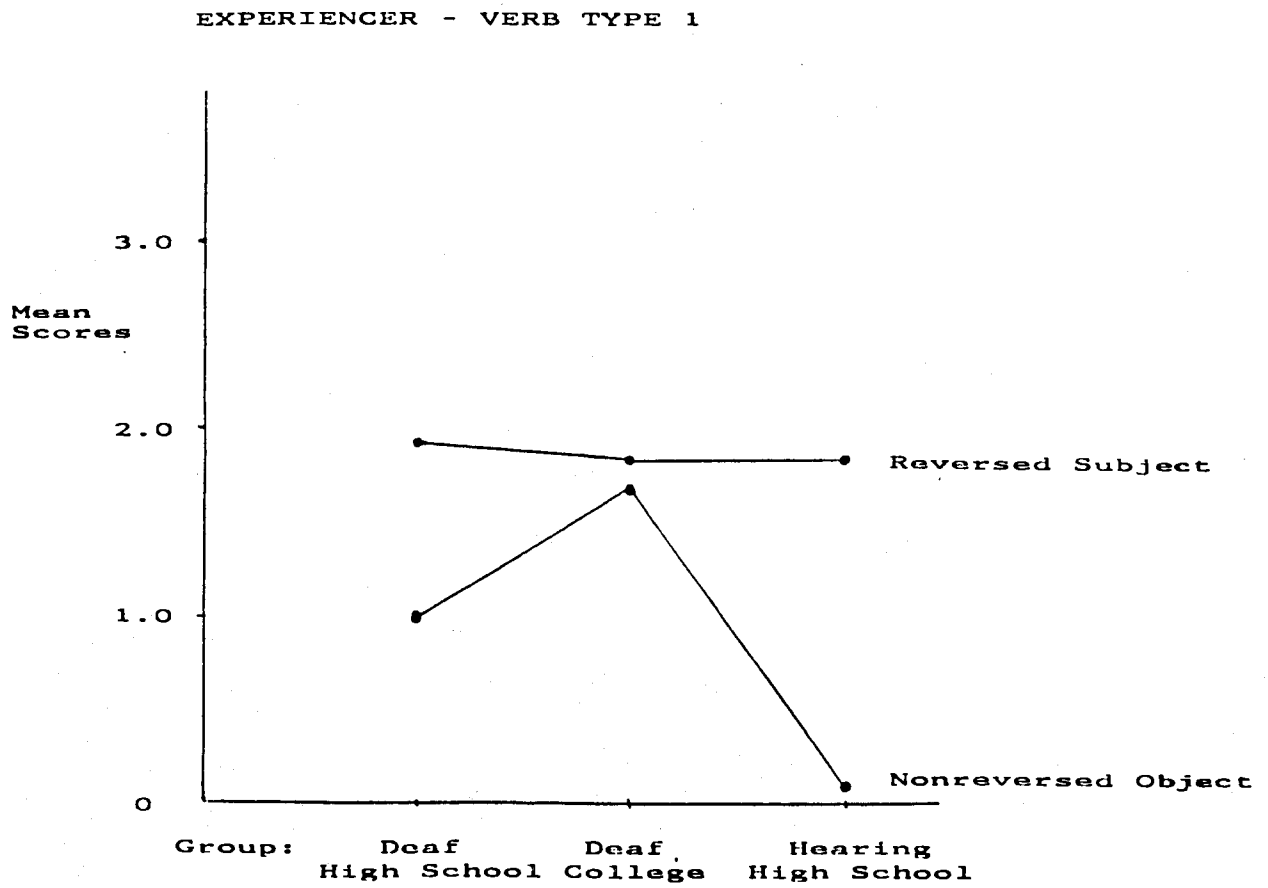

EXPERIENCER - VERB TYPE 1
3.0
Mean
Scores
2.0
1.0
0
Nonreversed Subject
Reversed Object
Group: Deaf High School
Deaf College
Hearing High School

Figure 5


EXPERIENCER - VERB TYPE 1
3.0
Mean
Scores
2.0
1.0
0
Reversed Subject
Nonreversed Object
Group: Deaf High School
Deaf College
Hearing High School

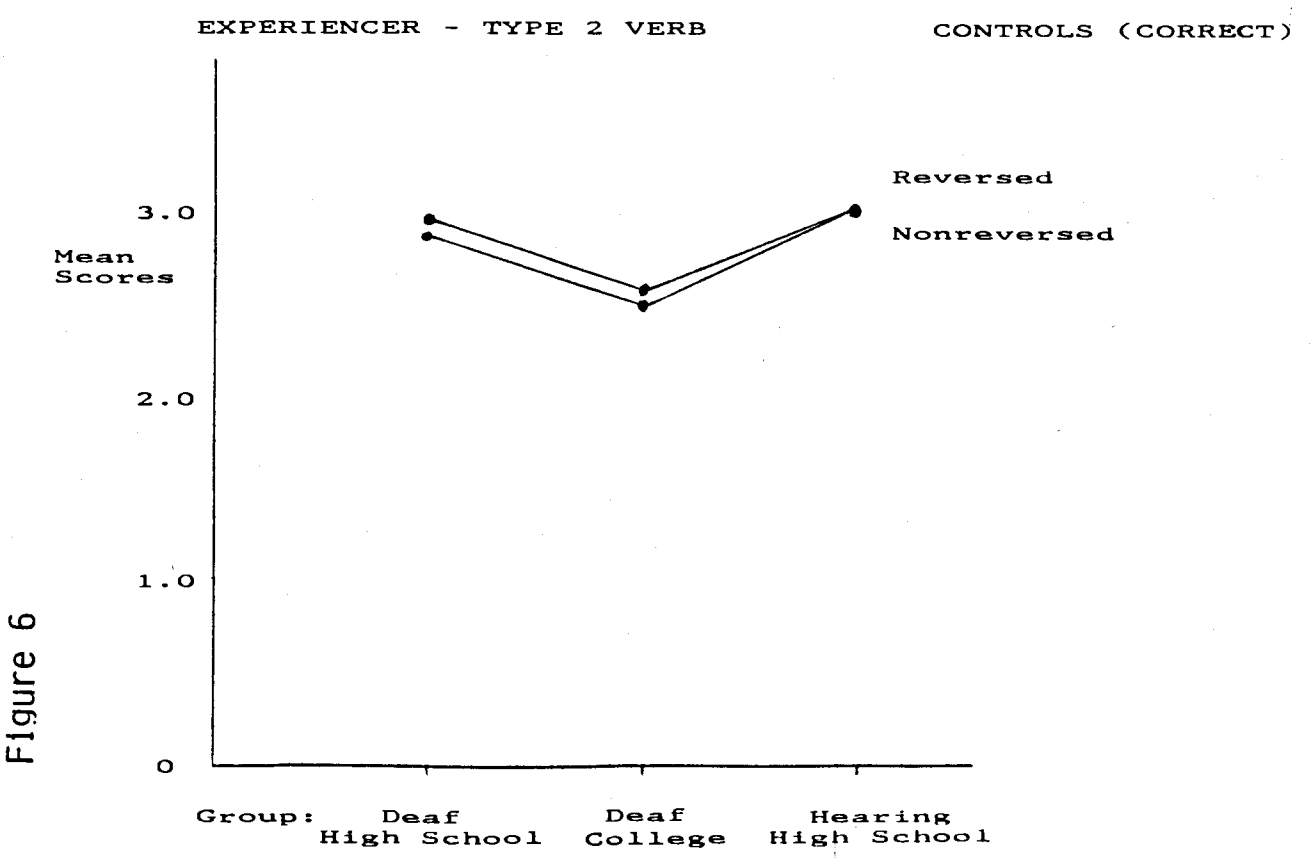

EXPERIENCER - TYPE 2 VERB
CONTROLS (CORRECT)
Reversed
Nonreversed
3.0
Mean
Scores
2.0
1.0
0
Group:
Deaf
High School
Deaf
College
Hearing
High School

Figure 6

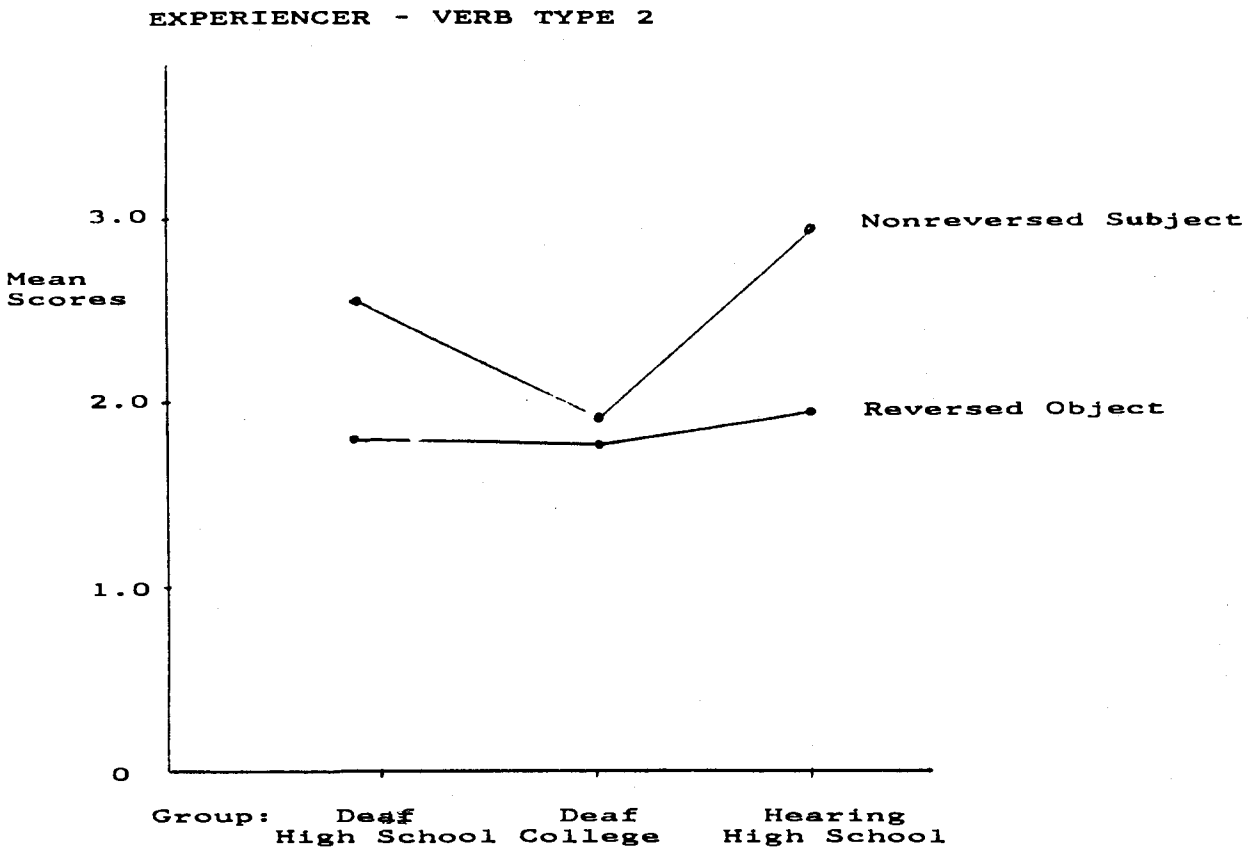

EXPERIENCER - VERB TYPE 2
3.0
Mean Scores
2.0
1.0
0
Nonreversed Subject
Reversed Object
Group: Deaf High School
Deaf College
Hearing High School

Figure 7

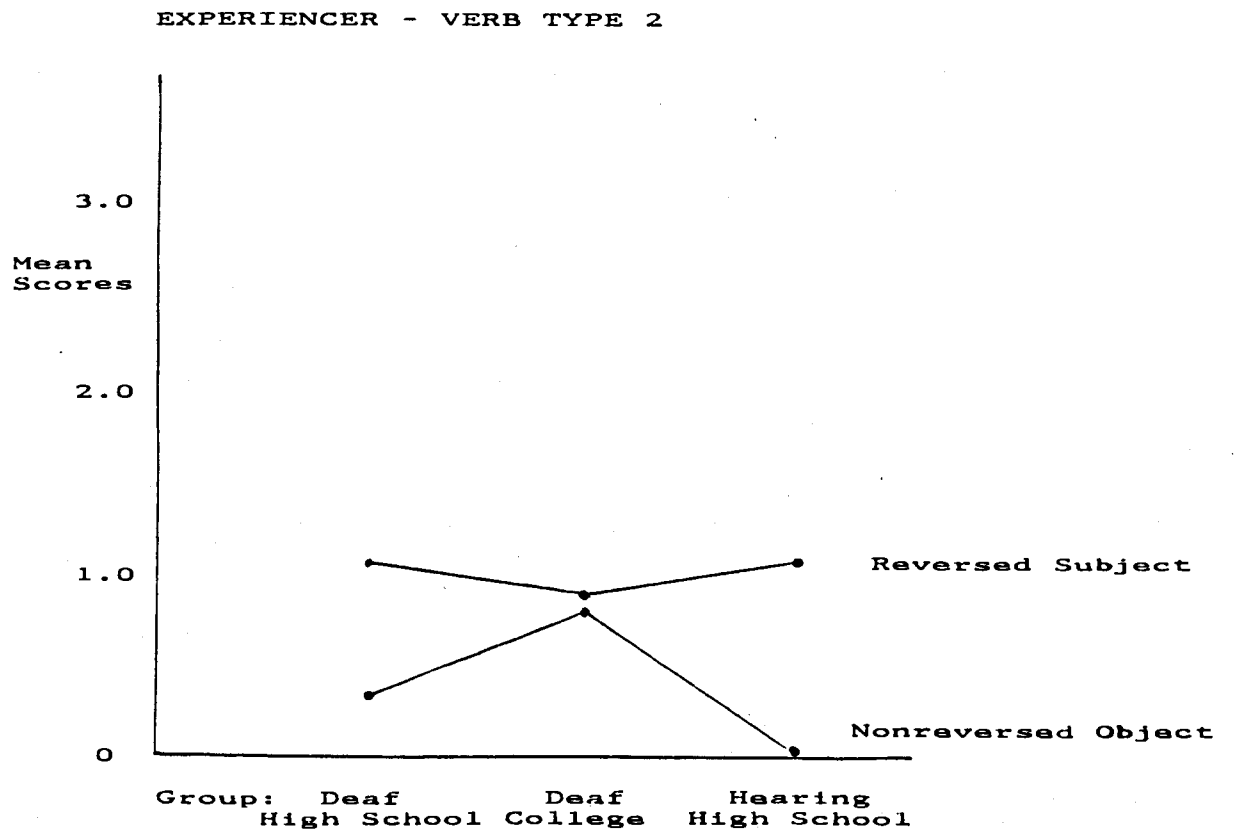

EXPERIENCER - VERB TYPE 2
3.0
Mean Scores
2.0
1.0
0
Reversed Subject
Nonreversed Object
Group: Deaf High School
Deaf College
Hearing High School

Figure 8

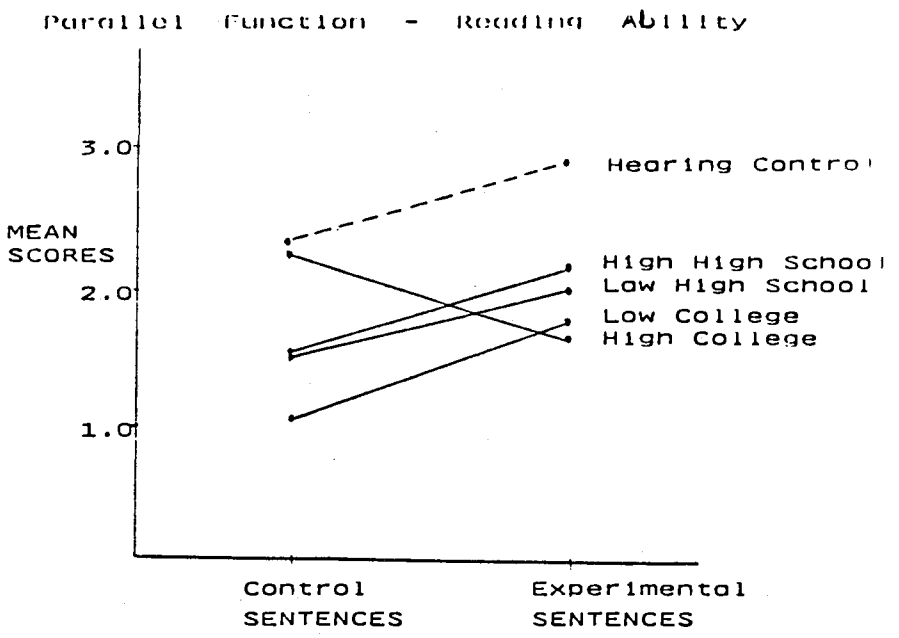
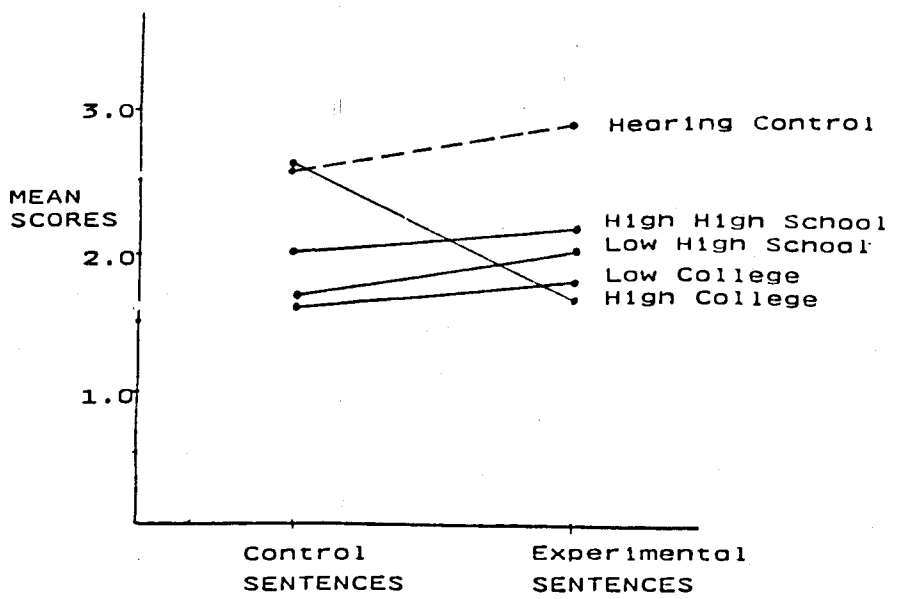


Figure 9



Appendix A

Background Data of Subjects in the Study

I. Deaf High School Subjects

A. Age Range ($\underline{M}$ = 16.9, $\underline{SD}$ = 1.13)

15 to 16 years old	7
16 to 17 years old	12
17 to 18 years old	11
18 to 19 years old	8

B. Grade in School

Freshman	3
Sophomore	9
Junior	18
Senior	8

C. Reading and Language Levels: Most recent scores from the Stanford Achievement Test, Hearing Impaired Edition, 1981

(Reading $\underline{M}$ = 6.05, $\underline{SD}$ = 2.79; Language $\underline{M}$ = 6.78)

Grade Level	Number of Subjects	
	Reading	Language
1.5 to 2.5	3	1
2.6 to 3.5	4	1
3.6 to 4.5	4	5
4.6 to 5.5	11	5
5.6 to 6.5	2	5
6.6 to 7.5	4	9
7.6 to 8.5	0	5
8.6 to 9.5	6	3
9.6 to 12.0	4	4

D. Cause of Deafness

Etiology unknown	22
Genetic	7
Maternal rubella	2
Premature birth	2
Meningitis	1
Mumps	1
Tumor	1
Turner's Syndrome	1
Waardenburg's Syndrome	1

E. Age or Onset

At birth	35
Before age 1.8 years	3

F. Age at Detection

At birth	31
Before age 2.0 years	4
Before age 4.0 years	3

G. Degree of Hearing Loss (Better Ear Unaided, ANSI, 1969)

61 to 70 dB	2
71 to 80 dB	12
81 to 90 dB	4
91 to 110 dB	20

H. Parental Hearing Status: All parents hearing.

I. Mode of Communication at Home

Entirely oral	23
Rarely sign	1
Mostly sign	14

J. Use of Hearing Aids

Always	31
In School Only	3
Never	4

K. Educational Settings

Oral Schools	0 to 3 years	7
	4 to 6 years	5
	7 to 9 years	1
Total Communication	0 to 3 years	1
	4 to 6 years	8
	6 to 12 years	13
	12 to 16 years	16
Residential schools	4 years	2

L. Has Deaf Adult Friends: 19 subjects

II. Deaf College Subjects

A. Age Range ($\underline{M}$ = 20.9, $\underline{SD}$ = .76)

19 to 20 years old	2
20 to 21 years old	16
21 to 22 years old	2

B. Reading and Language Levels: Most recent scores from the Stanford Achievement Test, Hearing Impaired Editions, 1978, 1981

(Reading $\underline{M}$ = 3.94, $\underline{SD}$ = 1.35; Language $\underline{M}$ = 4.23)

Grade Level	Number of Subjects	
	Reading	Language
1.0 to 2.5	4	3
2.5 to 3.5	3	3
3.6 to 4.5	7	7
4.6 to 5.5	3	3
5.6 to 6.5	0	3
6.6 to 7.5	2	1
7.6 to 8.5	0	0
8.6 to 9.5	1	0

C. Cause of Deafness

Maternal rubella	11
Etiology unknown	4
High fever	3
Toxoplasmosis	1
Premature birth	1

D. Age of Onset

At birth	16
Before age 1.8 years	4

E. Age at Detection

At birth	16
Before age 2.0	2
Before age 4.0	2

F. Degree or Loss (Better Ear Average Unaided, ANSI, 1969)

61 to 70 dB	0
71 to 80 dB	6
81 to 90 dB	7
91 to 110 dB	7

G. Parental Hearing status: All parents hearing.

H. Mode of Communication at Home

Entirely oral	11
Rarely sign	2
Mostly sign	7

I. Use of Hearing Aids

Always	11
In School Only	4
Never	5

J. Educational Settings

Oral Schools	0 to 3 years	7
	4 to 6 years	3
	7 to 9 years	2
	10 to 13 years	2
Total Communication	0 to 3 years	0
	4 to 6 years	1
	6 to 12 years	5
	12 to 16 years	14
Residential Schools	3 years	2
	8 years	2
	12 to 14 years	4

K. Has Deaf Adult Friends: All subjects

Appendix B
Statistical Data For Analyses of the Study

Table B-1

Repeated Measures ANOVA: Parallel Function Sentences

Source	SS	df	MS	F	Tail Probability
Group	77.99570	2,128	38.99785	56.54	0.0000*
Sentence[a] Type	20.27650	1,128	20.27650	33.81	0.0000*
Sentence Type x Group	6.28271	2,128	3.14135	5.24	0.0065*
Condition[b]	2.71145	1,128	2.71145	5.64	0.0190*
Condition x Group	0.62463	2,128	0.31232	0.65	0.5328
Sentence x Condition	20.54902	2,128	20.54902	40.29	0.0000*
Sentence x Condition x Group	1.99130	2,128	0.99565	1.95	0.1462

[a] Sentence type = Experimental and Control.

[b] Condition = Non Reversed and Reversed.

* $p \leq .05$.

Table B-2

Repeated Measures ANOVA: Pragmatic I Sentences

Source	SS	df	MS	F	Tail Probability
Group	45.25064	2,128	22.62532	30.43	0.0000*
Sentence	0.34142	1,128	0.34142	2.49	0.1169
Sentence x Group	0.84444	2,128	0.42222	3.08	0.0493*
Condition	6.12051	1,128	6.12051	12.59	0.0005*
Condition x Group	2.39397	2,128	1.19698	2.46	0.0892
Sentence x Condition	0.40569	1,128	0.40569	2.54	0.1133
Sentence x Condition x Group	0.29848	2,128	0.14924	0.94	0.39542

*$p \leq .05$

Table B-3

Repeated Measures ANOVA: Pragmatic II Sentences

Source	SS	df	MS	F	Tail Probability
Group	80.54480	2,128	40.27240	45.17	0.0000*
Sentence	1.93310	1,128	1.93310	4.59	0.0341*
Sentence x Group	0.75541	2,128	0.37770	0.90	0.4107
Condition	18.75759	1,128	18.75759	34.95	0.0000*
Condition x Group	9.20932	2,128	4.60466	8.58	0.0003*
Sentence x Condition	0.34883	1,128	0.34883	0.73	0.3945
Sentence x Condition x Group	2.53277	2,128	1.126638	2.65	0.0746

*$p \leq .05$

Table B-4

Repeated Measures ANOVA: Experiencer Constraint Verb 1

Source	SS	df	MS	F	Tail Probability
Group	37.87851	2,128	18.93925	25.08	0.0000*
Sentence	59.76272	1,128	59.76272	109.56	0.0000*
Sentence x Group	2.86393	2,128	1.43196	2.63	0.0763
Condition	1.89950	1.128	1.89950	4.21	0.0422*
Condition x Group	13.17278	2,128	6.58639	14.61	0.0000*
Sentence x Condition	0.74353	1,128	0.74353	1.79	0.1834
Sentence x Condition x Group	12.98692	2,128	6.49346	15.62	0.0000*

*$p \leq .05$

Table B-5

Repeated Measures ANOVA: Experiencer Constraint Verb 2

Source	SS	df	MS	F	Tail Probability
Group	17.49849	2,128	8.74925	12.51	0.0000*
Sentence	110.43301	1,128	110.43301	245.14	0.0000*
Sentence x Group	0.49484	2,128	0.24742	.55	0.5787
Condition	49.19841	1,128	49.19841	147.38	0.0000*
Condition x Group	4.16046	2,128	2.08023	6.23	0.0026*
Sentence x Condition	56.72591	1,128	56.72591	186.97	0.0000*
Sentence x Condition x Group	2.88726	2,128	1.44363	4.76	0.0102*

*$p \leq .05$

Table B-6

Percentages of Correct Responses for All Sentence Variables for Each group of Subjects

	Hearing	Deaf	
Parallel Function			
NR Controls	.87	.50	.41* .58**
Rev Controls	.75	.38	.44 .32
NR Experimental	.85	.64	.75 .53
Rev Experimental	.90	.74	.79 .68
Pragmatic I			
NR Controls	.97 .53	.71	.89 .48
Rev Controls	.94 .62	.75	.87 .62
NR Experimental	1.00 .77	.86	.95 .77
Rev Experimental	.94 .60	.76	.91 .60

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Table B-6 (Continued)

Pragmatic II			
	Hearing	Deaf	
NR Controls	.89	.66	.85* .48**
Rev controls	.80	.47	.51 .43
NR Experimental	.87	.72	.81 .62
Rev Experimental	.84	.54	.64 .45

Experiencer Constraint - Control Sentences						
	Hearing		Deaf			
	By Verb	By Parallel Function	By Verb		By Parallel Function	
NR V1	.99	.01	.82	.93 .72	.18	.07 .28
Rev V1	.01	.98	.18	.09 .28	.82	.91 .72
NR V2	1.00	0	.90	.96 .83	.10	.04 .17
Rev V2	0	1.00	.08	.01 .15	.92	.99 .85

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Table B-6 (Continued)

Experiencer Constraint - Experimental Sentences						
	Hearing		Deaf			
	By Verb	By Parallel Function	By Verb		By Parallel Function	
NR V1	.95	.05	.54	.63* .45**	.43	.33 .53
Rev V1	.42	.58	.36	.36 .35	.60	.62 .58
NR V2	.01	.99	.21	.12 .30	.75	.85 .65
Rev V2	.36	.64	.34	.36 .32	.62	.62

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